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Seasonal Distribution and Migration of Rainbow Trout in the Kanektok River, 2009-2011

By

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and

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Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

Rainbow trout *Oncorhynchus mykiss* in the Kanektok River were radiotagged and tracked for two years to describe seasonal distributions, migration patterns and identify major spawning areas. From 3 to 12 August 2009, radio tags were surgically implanted into 200 rainbow trout ≥430 mm FL throughout 160 river kilometers (rkm) of the drainage. Radio tags were distributed uniformly at a density of 20 tags per 16.5-km river section to maximize detecting geographic (e.g., upper vs. lower river) differences in behavior that may exist in the population. A total of 36 aerial tracking surveys were flown from 16 August 2009 through 10 August 2011. Results of the study indicated that: 1) fish were most scattered in the summer months; 2) spawning and overwintering areas were relatively sparse in the upper half of the river, but pervasive in the lower half of the river; 3) peak spawning occurred from early to mid-June; 4) Kagati/Pegati lakes appear to be an important overwintering area for fish summering in the upper river; 5) mean annual home range of radiotagged rainbow trout was 21.2 rkm the first year (August 2009–August 2010) and 19.2 km the second year (August 2010–August 2011) with fish summering in the upper drainage typically having larger ranges; 6) the greatest seasonal movements occurred during fall and spring seasons; 7) on average, each rainbow trout returned to within 2.7 km of their previous summer location; and, 8) this study provided valuable information for designing future studies (e.g., abundance estimates) and evaluating previous studies of rainbow trout in the drainage.

Key words: rainbow trout, *Oncorhynchus mykiss,* telemetry, Kanektok River, Kanuktik Creek, movement, migration, home range, overwintering areas, seasonal distribution, spawning areas.

INTRODUCTION

The Kanektok River (Figure 1) is located in southwest Alaska between the Kuskokwim and Goodnews rivers. It originates in the Ahklun Mountains from Pegati and Kagati lakes (hereafter referred to as Kagati Lake) and flows westerly approximately 150 river kilometers (rkm) to the Kuskokwim Bay. The upper 117 rkm lies within the Togiak National Wildlife Refuge (TNWR) while the remainder flows primarily through Quinhagak Village corporation lands (Buzzell and Russell 2010). The community of Quinhagak is located near the confluence of the Kanektok River and Kuskokwim Bay. Many tributary streams feed the Kanektok River with the four largest being Takshilik, Nukluk, Klak, and Kanuktik creeks.

The Kanektok River is a natal stream for five species of anadromous salmon: Chinook *Oncorhynchus tshawytscha*, chum *O. keta*, sockeye *O. nerka*, pink *O. gorbuscha*, and coho *O. kisutch*. Anadromous Dolly Varden *Salvelinus malma* also spawn and reside in the system. Resident fish species inhabiting the Kanektok River watershed (including lakes) include the following: rainbow trout *O. mykiss*, Arctic char *S. alpinus*, northern pike *Esox lucius*, Arctic grayling *Thymallus arcticus*, burbot *Lota lota*, lake trout *S. namaycush*, whitefish *Coregonus*, blackfish *Dallia pectoralis*, and slimy sculpin *Cottus cognatus.*

The Kanektok River is one of the most popular remote rainbow trout fisheries in the state (Chythlook 2012). It has been highly publicized in a multitude of sport fishing articles and the term "leopard bow" was originally used to describe these fish, adding to the mystique of the river. The river was so highly regarded in the mid-1980s that it was often referred to as "the chosen river" in sport fishing publications. Total estimated angler effort increased rapidly from 1,500 angler-days in 1983 (Mills 1984) to over 12,500 angler-days in 1988 (Mills 1989) based on the Alaska Department of Fish and Game annual Statewide Harvest Survey (Table 1). When comparing the most recent 5 year periods, average annual fishing effort has decreased from 6,951 angler days for the years 2001 through 2005 to 5,899 angler days for the years 2006 through 2010 (Jennings et al. 2004, 2006a-b, 2007, 2009a-b, 2010a-b, 2011a-b).

Estimated angler catch of rainbow trout peaked in 1997 (Howe et al. 2001b) at over 27,000 rainbow trout (Table 1). Since then catches have dropped, but the most recent five year periods

reveal increasing catch. The annual mean catch of rainbow trout was estimated at 8,176 from 2001 to 2005. From 2006 to 2010, the annual mean catch was estimated at 12,528 rainbow trout (Jennings et al. 2004, 2006a-b, 2007, 2009a-b, 2010a-b, 2011a-b).

Estimated sport harvest of rainbow trout from the Kanektok River was modest prior to 1998 when harvest during the entire year was allowed. Estimated annual harvest varied from ~50 to 640 fish from 1983–1997 and averaged 220 rainbow trout (Table 1; Mills 1984-1994; Howe et al. 1995, 1996, 2001a-b). Since institution of the seasonal catch-and-release regulation in 1998 (June 8 to October 31), estimated annual harvest has averaged <15 rainbow trout (Howe et al. 2001c-d, Walker et al. 2003, Jennings et al. 2004, 2006a-b, 2007, 2009a-b, 2010a-b, 2011a-b).

Prior to 1998 and implementation of catch and release regulations throughout the majority of the open water season, various sport fishing regulations were in effect:

- In 1969, the fishing season was open year-round with a daily limit of 15 fish (including rainbow trout) of which not more than 3 could exceed 20 inches in length.
- In 1985, the rainbow trout bag limit was reduced to 2 per day with no size limit.
- In 1990, single-hook, artificial lures were required upstream of the Togiak National Wildlife Refuge boundary. The bag limit remained 2 fish, but only one could be over 20 inches. Sport fishing was prohibited within 300 feet of legally set subsistence gill nets.
- In 1998, the entire river was restricted to unbaited artificial lures the entire year. During June 8–October 31, rainbow trout could not be retained. The remainder of the year (November 1–June 7), the daily and possession limit was modified to 2 rainbow trout per day, only one of which could be larger than 20 inches.

Subsistence harvest of rainbow trout occurs in the Kanektok River drainage, and in the late 1980s annual harvest estimates were as high as ~2,000 fish (Wagner 1991). Rainbow trout are primarily harvested incidentally while subsistence users jig for Dolly Varden through the ice in winter or fish gill nets in the spring and fall (Willard Church, Native Village of Kwinhagak, Natural Resource Department, personal communication). No current information is available about rainbow trout subsistence harvest.

Public concerns about the increased popularity of the Kanektok River rainbow trout sport fishery in the 1980s (Dlugokenski et al. 1983) prompted the U.S. Fish and Wildlife Service (USFWS) to initiate a moratorium on issuance of new commercial sport fish guiding permits (USFWS 1991) and an intensive three-year study on rainbow trout (Wagner 1991). The study included collection of age, length, and weight information from 1,000 rainbow trout (1985–1987), a rainbow trout specific creel survey (1986–1987) and a rainbow trout abundance estimate using mark-recapture methods (1985–1986). The most precise reported estimate of abundance was 20,815 (95% CI = 16,049 to 25,581) rainbow trout ≥300 mm FL in a 33 rkm segment during 1986. Rainbow trout were sampled again for length and weight in the lower 28–60 rkm reach of the Kanektok River during 1993 (Adams 1996). These fish (n=827) were compared to the sampled lengths collected from 1985–1987 and were found to be significantly different, with more small fish (i.e., <400 mm FL) and fewer large fish (i.e., >600 mm FL) captured in 1993. No estimate of abundance was calculated during 1993 due to the small number of recaptured fish. During this same study, 26 rainbow trout were radiotagged and tracked for 10 months between October 1993 and August 1994. Most fish moved less than 10 rkm throughout the study period. In 2000, the same river reach (rkm 28–60) was sampled, and 225 rainbow trout were measured and compared to the 1985–1987

and 1993 study results (Larson 2008). The length distribution of sampled fish during 2000 was significantly different than those sampled from 1985–1987 and 1993. A greater number of small rainbow trout were observed in the later experiment. In addition to these studies, several creel surveys have been conducted on the river since 1986, and although most were not specific to rainbow trout, catch and harvest information for rainbow trout was typically gathered (Alt 1986; Minard 1987; Dunaway and Bingham 1992; Dunaway and Fleischman 1995).

Information on both population size and life history is needed to evaluate the overall health and long-term sustainability of rainbow trout in the Kanektok River. The life history information is required to determine if unique sub-populations or stocks exist within the drainage that could be affected by differential harvest patterns or environmental factors occurring throughout the watershed. Telemetric studies have demonstrated that rainbow trout within a drainage can be composed of multiple spawning stocks; can exhibit either extreme or little fidelity to spawning, feeding, and overwintering areas; and can exhibit either very small (e.g., < 3 rkm) or large (> 100 rkm) intra-annual movements (Adams 1996, 1999; Faustini 1996; Lisac 1996; Schwanke and Hubert 2000; Nelle 2002; Meka et al. 2003; Fleming 2004; Schwanke and Thalhauser 2011).

The goal of this study was to collect whole-river information on the seasonal movements and putative spawning areas of rainbow trout in the Kanektok River watershed. In the absence of recent abundance–based information, quantifying rainbow trout movements will help to identify the distribution(s) of those fish affected by inriver fisheries.

OBJECTIVES

Specific objectives for 2009 through 2011 were to:

1. Describe the seasonal (summer 2009 to spring 2011) distributions of mature sized rainbow trout ≥430 mm FL in the Kanektok River implanted with radio transmitters during the summer feeding period when rainbow trout distributions are most dispersed; and,
2. Identify potential spawning areas of rainbow trout.

METHODS

STUDY AREA

The study area, as it related to sampling fish, included the mainstem Kanektok River from the outlet of Kagati Lake down to the village of Quinhagak (~145 km), the lower 17 rkm of Kanuktik Creek, and the lower 1 rkm of three additional tributaries - the Klak, Nukluk, and Takshilik creeks (Figure 1).

The aerial tracking search area extended along the mainstem Kanektok River from Quinhagak upstream to and including all of Kagati Lake as well as several km upstream in Klak, Nukluk, and Takshilik creeks. Early in the study, flights were conducted near the mouth of the Kanektok River over saltwater searching for dead rainbow trout that may have washed out of the study area.

STUDY DESIGN

The study area was divided into 10 equal sections approximately 16.5 rkm in length (Figure 1). Each section was sampled for an entire fishing day (~10-12 h). During the first two weeks of August 2009, 200 rainbow trout ≥430 mm FL were radiotagged throughout the entire drainage. Rainbow trout ≥430 mm FL were used because they were suspected to be mature based on

earlier studies of rainbow trout in southwest Alaska (Wagner 1991; Gwinn 2005; Dye 2008). We attempted to disperse radio tags throughout each section to avoid concentrations and to maximize our chances of detecting unique behavior (e.g., discrete spawning populations). To facilitate sampling, and to help with data analyses and presentation, each section was assigned an alphabetic letter (Sections A–I and K). Tags not deployed in their designated section (n=9) were distributed into the lower 1 rkm of Klak, Nukluk, and Takshilik creeks. These radiotagged fish were included in the analysis with the rest of the fish tagged in the section where the tributary confluences are located (E and F).

Radiotagged fish were monitored over a 24-month period to describe seasonal movements, overwintering locations, and potential spawning areas.

FISH CAPTURE AND TELEMETRY PROCEDURES

Rainbow trout were captured using hook-and-line gear from 3 to 12 August 2009 using four two-person crews. Three crews accessed the Kanektok River via Kagati Lake with two DeHavilland Otter flights. The fourth crew began the trip by accessing Kanuktik Creek via a small headwater lake (59.8053° N, 160.2891° W; WGS84) using a DeHavilland Beaver. All four crews met up at the lower end of section H near the end of day 2. Terminal hook-and-line gear consisted of pegged beads, rubber grubs, flies, and spinners (sometimes tipped with shrimp or salmon roe to expedite sampling). The timing of this study coincided with Chinook and chum salmon spawning periods.

On day five of sampling, all field crews arrived at the fish weir operated by the Alaska Department of Fish and Game (ADF&G) (59.7676° N, 160.0603° W; WGS84). At this time, three raft crews continued sampling the remaining 16.5 rkm reaches down to Quinhagak. The fourth crew of now three people (a crew member from the weir site was added) used a jet-powered boat to deploy three tags in each of the lower reaches of Takshilik, Nukluk, and Klak creeks during the next 1.5 days before rejoining the rest of the sampling crews.

Radio tags were manufactured by Lotek Wireless Incorporated® (Model SR-M11-25). The tags measured 11x54 mm, weighed 9.5 g in air, were digitally encoded and equipped with a motion sensor and programmed to operate daily for 12 hours between 0800 and 2000 h. Tag life was extended to 735 d using the programming schedule. The 200 unique tags emitted signals every 4-s to 4.5-s and were divided evenly among four radio frequencies ranging between 162.31875 and 162.38125 MHz. The motion sensor emitted a unique code when a tagged fish was inactive. Inactivity was triggered after satisfying a preprogrammed time (24h) and sensitivity level (1) criterion. Inactive tags were interpreted as either an expelled tag or a dead fish.

Radio tags were surgically implanted following well-established procedures (Winter 1983; Summerfelt and Smith 1990). Fish selected for radiotagging were anesthetized using procedures outlined by Brown et al. (2002). Once a fish was anesthetized, fork length measurements were taken to the nearest mm and a small (~1-cm^2) portion of pelvic fin was collected for future genetic analysis. Each fin clip was stored in an individually numbered vial filled with desiccant for preservation.

Anesthetized fish were placed ventral side up in a padded cradle, and gills were irrigated with water/anesthesia solution throughout the surgical procedure. All surgical utensils were disinfected in a Nolvasan™ solution and rinsed with saline solution prior to surgery. Surgery began by cutting a 15-mm incision anterior to the pelvic girdle, along the left ventral side, about

5–10 mm from the midventral axis. A grooved director was placed into the coelomic cavity through the incision to direct a 16-ga 25.4-cm hypodermic needle inserted from posterior of the pelvic girdle towards the incision (Brown et al. 2002). The tag antenna wire was routed from the incision past the pelvic girdle by threading the wire through the needle. Upon exit, the needle and grooved director were removed and the radio tag fully inserted into the coelomic cavity. The incision was sutured with 3 to 4 simple, interrupted stitches of monofilament suture material (Wagner et al. 2000) and treated with a surgical adhesive (Vetbond™). After surgery, fish were immediately placed into a large recovery tote filled with fresh river water to regain equilibrium prior to being released in a slow-flowing portion of the river. A Floy® T-bar anchor tag was applied to all radiotagged fish near the base of the dorsal fin. Each anchor tag was labeled with a unique three-digit number and a toll-free phone number for the TNWR office in Dillingham.

Radiotagged rainbow trout were relocated using radio receivers manufactured by Lotek Wireless Incorporated® (Model SRX 600) and aerial tracking techniques. A total of 36 tracking flights were performed between August 2009 and August 2011. The survey frequency was generally one survey per month; however, during April, May, and June three surveys per month were conducted to better assess spring movements to probable spawning locations.

Aerial surveys were flown 100 to 300 m above ground elevation with a Found Bushhawk fixed-wing aircraft wired for telemetry. Two radio receivers operating in tandem each scanned two distinct frequencies at 5-s intervals. Each receiver included an internal global positioning system (GPS) and an external magnetic antenna to automatically record the time and location of detected fish. Two H-antennas (162–166 MHz), one mounted on each wing, were connected to a splitter and controlled by a selecting switch. The primary search areas included Kagati Lake, the Kanektok River down to Kuskokwim Bay, Kanuktik Creek, and several km of the Lower Klak, Nukluk, and Takshilik creeks. The survey area was extended in tributaries during the summer months when the fish distribution was suspected to be more widespread. During low tide periods tracking flights were extended over saltwater at the river mouth to search for dead rainbow trout that may have washed out of the system.

A digitized map of the Kanektok River system was obtained from the National Hydrography Dataset (NHD) (NHD 2011). Individual segments of the study area were extracted and then dissolved together to form a precise track of the Kanektok River drainage and imported into ArcGIS® version 9.3.1. Distance markers were placed every 0.10 km along the centerline of the river, tributaries, and lakes using the "Convert Paths to Points" tool in Hawth's Analysis Tools (Beyer 2004).

Multiple locations, times, and signal strengths of detected fish were logged with the radio receivers during each survey. All data were downloaded from the two receivers using Lotek Wireless Incorporated® WinHost® proprietary software and converted to an Excel® spreadsheet (Lotek 2005). Specific locations of tagged fish were determined for every survey by selecting the highest signal strength from a series of logged locations for each identified fish. For the data analyses, GPS locations for each fish were adjusted to the nearest distance marker using the "Point Global Snap" tool in ET Spatial Techniques (Tchoukanski 2010). To minimize overlapping fish locations, unsnapped locations of fish (i.e., where the airplane was when the highest signal strength was recorded) were used when making the figures of this report.

All biological and telemetric data were entered and archived in an Excel® spreadsheet (Appendix A).

DATA ANALYSIS

After the location of each fish was plotted on a map, fish locations were labeled by survey, and individual fish were assigned a fate of active or alive (A), inactive or dead (I) or at-large or missing (AL). The fate of each fish was determined by examining the movement history and data provided by the motion sensors. Reviewing the movement history of each radiotagged fish was required because the motion sensor sometimes did not accurately reflect the fate of a tagged fish during a given survey. The history of sensor recordings for each fish was then examined to decipher when and if the fish had died, and its fate was corrected for subsequent surveys. For example, a fish with an inactive signal for one or more surveys that later made significant movements and emitted an active signal was considered alive for the inactive period. Conversely, when a fish emitted an active signal intermittently, all the while exhibiting no detectable movement throughout the tracking history, it was considered dead at the time when the first of consecutive inactive signals occurred. By the end, all fish were classified as alive, dead or missing.

At-large fish were excluded from the data analyses for that particular flight. These fish may have left the study area, experienced tag failure or been overlooked during a particular survey. If the fish was relocated on subsequent surveys its movement history was included in the final analysis.

Seasonal Distribution

Seasonal designations of summer (July–October), fall (November–December), winter (January–April) and spring (May–June) were used to describe the seasonal distributions and movements of radiotagged fish throughout the study period. Distributions and movements were suspected to differ among seasons with minimal movement occurring during summer and winter seasons and greater movement during the fall and spring transition seasons (Palmer 1998; Schwanke and Thalhauser 2011). Distributions and movements of radiotagged fish were determined by assigning each detected fish a river section and rkm after each survey (e.g., Section B; rkm 23.8). Time periods used to define seasons were determined by analyzing movement information collected throughout the entire study period. Distributions of radiotagged fish were determined for each survey and reported as a percentage by dividing all the detected tags within each section during a survey by the total radio tags detected. Seasonal distributions were the average percent distributions from all surveys flown in a given season.

Movement

Movements of radiotagged fish were analyzed and summarized by plotting coordinates of all located fish deemed to be alive at the time of each survey onto a digitized map of the drainage using the program ArcGIS®. Variables measured to describe fish movement included net movement between tracking events, home range of radiotagged fish surviving year one and two, and annual fidelity to summertime tagging locations.

Net Movement

The net movement (distance) between tracking events was determined by subtracting the river locations (i.e., 0.1 rkm assignments) of individual fish that were detected during consecutive surveys. These distances were summarized and reported as absolute values. Because the time between surveys varied throughout the study period, movements were summarized using descriptive statistics (i.e., mean, minimum, maximum and SD). Fish that were not found alive during consecutive surveys were not used in the analysis. The net movement was further

summarized into seasons by averaging all the periods for each season. When the time between surveys overlapped seasonal designations, the mean net movement was assigned to the season that comprised the greatest number of days for the time period. For example, the survey period 26 October to 17 November spanned the designated summer (6 days) and fall (23 days) seasons. The mean net movement of 5.3 rkm was assigned to the fall season because the majority of the period (17 of the 23 days) occurred during the fall.

Home Range

Home ranges were determined for fish that survived year one (tagging to 18 August 2010) and year two (18 August 2010 to 10 August 2011) of the study. Home range was determined as the distance measured between the upper- and lower-most extent of a radiotagged fish located within the drainage over the course of a year. The home range of fish moving into a tributary was the sum of the mainstem Kanektok River extent and the distance traveled in the tributary. To facilitate comparisons, fish were then grouped based on their original tagging section (i.e., sections A–I, and K) and summarized using descriptive statistics.

Summertime Fidelity

Fidelity to summertime tagging locations was examined by measuring the distances between August summer locations from one year to the next. Dates chosen for these analyses were 3–12 August 2009 (tagging period), 18 August 2010 and 10 August 2011. August was examined for site fidelity because this is a common time to conduct rainbow trout assessment surveys in southwest Alaska and this information is important to future tagging or mark-recapture studies. Fidelity during other time periods could be examined in the future if warranted.

Spawning Distribution

Spawning was determined by examining fish movements during the spring period (May and June) when rainbow trout are known to spawn in this region (Gwinn 2005; Dye 2008; Schwanke 2009). Pre- and post-spawn movements of radiotagged fish were used to determine the peak spawning period. The peak spawning period was defined as the period of time when the least amount of movement was observed during the suspected spawning season (i.e., the time period when pre-spawn migrations had subsided and post-spawn movements had yet to increase). Radiotagged fish identified on consecutive surveys during the peak spawning period were used to illustrate the spawning distribution in Kanektok River drainage.

RESULTS

SUMMARY OF FISH CAPTURED

Rainbow trout ≥430 mm FL (n=200) were surgically implanted with radio tags from 3 to 12 August 2009 (Appendix B). Fork lengths of radiotagged fish ranged from 430 to 680 mm and averaged 493.5 mm (SD = 50.9; Figure 2; Table 2). The number of radio tags deployed in each length category mirrored the normal length distribution of all caught fish ≥430 mm FL (Figure 2). Over half of all radiotagged fish were between 430 and 490 mm FL.

Tag deployment occurred mostly as planned and was relatively uniform throughout the drainage (Table 3; Figure 3). Tag deployment spanned 160 rkm ranging from 4.3 rkm below Kagati Lake to 8.4 rkm above Kuskokwim Bay (Figure 3). Tags were distributed throughout 140 rkm of mainstem Kanektok River, 17 rkm of Kanuktik Creek, and ~3 rkm total within Klak, Nukluk,

and Takshilik creeks. The average number of rainbow trout captured in each section was 52. The least number of fish were caught in section K, whereas the greatest number of fish were caught in section C (Table 2).

RADIOTRACKING

Overview

A total of 36 aerial surveys were conducted from 16 August 2009 to 10 August 2011 (Table 4). The surveys on 5 July 2010, 6 October 2010, and 5 July 2011 were incomplete due to unfavorable survey conditions (high winds or fog). Information collected from these three incomplete surveys are reported but were omitted in parts of the analysis. Active rainbow trout were relocated over a cumulative range of 180 rkm, from 2.3 rkm above the ocean confluence to the eastern end of both arms of Kagati Lake and up Kanuktik Creek 18.5 rkm.

Radiotagged rainbow trout determined to be "active" decreased throughout the study period. The initial survey that was flown immediately after completion of tagging yielded 185 active and 7 inactive fish (Table 4). The fish that survived to the first survey provided from 4 to 737 days (mean 299.3 days; SD 284) of available tracking data (Appendix B). A total of 62 fish remained active throughout the first complete year of the study (16 August 2009–18 August 2010; Table 4). The total number of active fish dropped to 34 by the end of the study on 10 August 2011. A total of 55 were at-large (or their batteries expired) and 111 were determined to be dead on the final survey.

Seasonal Distribution

Radiotagged rainbow trout exhibited different distributions and movements among seasons (Figures 4–9). Fish were most uniformly distributed during the summer season with less than 13% and 16% of all radiotagged fish found in any one section during 2009 and 2010, respectively (Figures 4 and 5). In contrast, winter was the most concentrated season with 49% and 51% of all detected radiotagged fish found in sections D and E (Figure 4 and 7). Overwintering areas appeared limited in the upper river where only a few clusters of fish remained. Small numbers of fish utilized Kagati Lake during the fall, winter, and spring seasons even though no radio tags were deployed in the lake (Figures 4, 6–8). No fish were found to make significant migrations into the Klak, Takshilik, or Nukluk creeks or any of the other unnamed tributaries. Kanuktik Creek was the most important tributary to radiotagged fish during the summer seasons (Figures 4 and 5).

Fish tagged in the upper river sections generally had the widest distributions among seasons (Figures 10–19). Fish tagged in section H had the widest seasonal distribution, with fish dispersed from section A to Kagati Lake (section L) at times throughout the study (Figure 17). Fish radiotagged in the lower half of the river (i.e., sections A–E) moved very little among seasons and typically moved less than 2 river sections among seasons (Figures 10–13).

Movement

Movement information and areas important to radiotagged fish were well documented and summarized for each season during this study (Figures 4–9; Table 6). Radiotagged fish remained relatively stationary throughout the summer season moving on average 1.5 rkm during 2009 and 1.3 during 2010 (Figure 9; Table 6). Radiotagged fish moved the greatest during the fall season with average movements of 6.3 rkm and 6.4 rkm each fall. Rainbow trout started migrating to

overwintering areas in late October/early November and continued to move throughout December and early January (Table 6). Spring movements were less than fall movements but were nearly double the movements observed during winter and summer seasons (Figure 9). Spring migrations typically began in early May, and spawning appeared to have peaked by early- to mid-June (Table 6). Migrations to summering areas commenced shortly after spawning and were complete by mid-July (Table 6).

Net Movement

Mean net movements during each season were nearly identical from one year to the next (Figure 9). Rainbow trout exhibited the greatest net movement during the fall season from 17 November to 23 December 2010 (mean = 7.3 rkm) and 19 November to 6 January 2011 (mean = 10.4 rkm) surveys (Table 6). The least amount of net movement occurred during summer and winter seasons with mean net movements generally ≤1.5 rkm for the each season (Figure 9; Table 6). Net movements for spring averaged 3.6 rkm and 3.5 rkm during 2010 and 2011, respectively, with peak net movements occurring from 24 May to 5 June 2010 (6.1 rkm) and 11 May to 27 May 2011 (5.5 rkm) (Table 6).

Home Range

Home ranges were determined for 62 and 30 radiotagged fish during year one and year two of the study, respectively (Table 7). Mean home ranges were similar among years, averaging 21.2 rkm and 19.2 rkm, and ranging between 1 rkm and 112.1 rkm (Table 7). Fish that were tagged in the Kanuktik Creek tributary had some of the largest home ranges with 67% of fish surviving the first year ranging >40 rkm (Table 8; Figure 19). Rainbow trout tagged in section H had the greatest mean home range of 47.2 rkm and 48.7 rkm during 2009/2010 and 2010/2011, respectively (Table 8; Figure 17). Fish radiotagged in sections C and D exhibited the smallest annual home ranges (Table 8; Figures 12 and 13). Sample sizes by river section were much lower during year two; however, home ranges were similar to the previous year (Table 9).

Summertime Fidelity

Mean summertime fidelity was similar between year one (2.7 rkm) and year two (2.8 rkm; Table 10). Measured differences between August locations during year one ranged from 0.0 rkm to 35.1 rkm. Similar results (0.0 rkm to 34.9 rkm) were observed during the second year (Table 10).

Spawning Distribution

Net movement between consecutive surveys during May and June of each year indicate that the peak spawning period occurred from 5 to 10 June 2010 and 6 to 15 June 2011(Table 6). Mean net movement between these annual consecutive surveys dropped to 2.3 rkm and 1.1 rkm, respectively. Fish observed on these surveys were used to illustrate suspected spawning locations (Figure 20). Spawning appeared prevalent throughout the middle and lower mainstem Kanektok River. Rainbow trout in sections D and E comprised the largest portion of the distribution during the peak spawning period during 2010 (surveys on 5 & 10 June combined–35%) and 2011 (surveys on 6 & 15 June combined–44%) (Table 5). Spawning was limited to two main areas in the upper river within 16 rkm of Kagati Lake (Figure 20). No radiotagged fish were thought to have spawned in Kanuktik Creek as no fish returned to this creek until 5 July 2010 and 10 August 2011. Spawning areas identified during 2011 were similar to 2010 (Figure 20).

DISCUSSION

A sample size of 200 radio tags in the Kanektok River was relatively large compared to most previous Alaska rainbow trout telemetry studies, especially when considering the size of the drainage. This sample was successful in identifying a broad range of seasonal fish behaviors and distributions at a relatively fine scale by river section.

Radiotagging fish ≥430 mm FL was a challenge in the upper-river sections (i.e., F, G, H and K) where densities of fish appeared to be low. The total number of fish captured was <40 in each of these four sections, and the tagging goal was not achieved in two of these sections. The fish radiotagged in these areas generally exhibited some of the largest seasonal movements, home ranges, and distributions. Conversely, the fish radiotagged in the middle and lower river sections (A, B, C, D and E) exhibited some of the least seasonal movements, smallest home range, and tightest distributions relative to their original tagging locations (Figures 10–19). Similar observations were found on the Aniak River where rainbow trout tagged in the upper tributaries (i.e., the Salmon and Kipchuk rivers) moved the farthest seasonally, while fish tagged in the lower mainstem of the Aniak River moved very little seasonally (Schwanke and Thalhauser 2011). It appears that habitat may be limited in the upper river sections during certain seasons forcing fish to migrate, primarily during the fall and spring periods. The lower river sections appear to provide abundant food sources as well as suitable summering, overwintering, and spawning habitat.

Previous studies of Kanektok River rainbow trout have focused on fish that were in the vicinity of sections C and D. Age, length, and abundance parameters were used from this section of river in earlier studies (Wagner 1991; Adams 1996; Larson 2008) to assess the status of rainbow trout in the Kanektok River. Adams (1996) radiotagged and tracked 26 mature rainbow trout from August 1993 through August 1994. Seasonal movements were reported to be minimal throughout the study with approximately 61% of the fish documented to have an annual home range of less than 10 rkm (range 3–35 rkm). The results of this study are similar; indicating that rainbow trout caught during summer months in sections C and D would likely provide a good assessment of the rainbow trout population when compared among years. However, fish in this reach of river may not be a useful surrogate to address the status of rainbow trout summering in the Upper Kanektok River.

Radiotagged rainbow trout exhibited high summer site fidelity often times returning to the same summer location from one year to the next. This suggests that certain groups of fish could have higher catch rates during the summer period depending on their accessibility. Fish found in the middle sections of the river may be subjected to the most directed sport fishing effort while fish in the lower river may be subjected to subsistence harvest and sport catch and harvest.

Kagati Lake appears to provide important refuge habitat for rainbow trout in the Upper Kanektok River. The lake was used seasonally by 9 different fish (8 from Section I and one from section H) throughout the study. Adfluvial populations of rainbow trout have been well documented throughout Alaska (Russell 1977; MacDonald 1996; Lisac and MacDonald 1997; Palmer 1998; Schwanke and Hubert 2000; Nelle 2002; Meka et al. 2003; Dye 2008), with some populations utilizing lakes to predominately summer and overwinter. Kagati Lake was predominately used for overwintering, although two tagged fish did utilize the lake at different times between June and August 2011.

The extensive migrations of rainbow trout that we documented have been reported by others in

Alaska rivers. Meka et al. (2003) documented a fish with a home range of ~102 rkm over the course of a year in the Alagnak River drainage and Nelle (2002) had several fish with a home range >50 rkm (max of 68 rkm) over a one year period in the Togiak River. We documented similar migrations for four unique fish that had annual home ranges >70 rkm during one or both years of the study. One of these fish had an estimated home range of 108.7 rkm the first year of the study and 112.1 rkm the second year. Like many fish in this study, this fish had strong fidelity to its summering location and was found in the same location during August 2009, 2010, and 2011. Although migrations this extensive were not frequent in this study, it appears to be an important life-history strategy for some rainbow trout in the Kanektok River, particularly those summering in the upper river sections.

Documenting spawning areas for riverine populations of fish can be difficult using radiotelemetry alone. The biggest constraints we encountered was the absence of spawning life-history information for rainbow trout in southwest Alaska and the inability to ground truth our observations from aerial flights. Information such as length-at-maturity and frequency of spawning are often unknown when planning telemetry studies. The minimum size cutoff of 430 mm FL was selected based on length frequency distributions of mature spawning rainbow trout in other Alaska rivers and because densities of larger fish (e.g., 450 mm FL) may have been too low to reasonably achieve sample size objectives. The hope was that the majority (i.e., >90%) of the radiotagged fish would spawn during this study. Interpreting spawning behavior using radiotelemetry is difficult because the exact time of spawning is often ambiguous when minimal pre- and post-spawn movements are observed. An attempt was made to assign each individual fish a spawning location based on its movement, but this proved to be difficult because of the lack of observed movements with many of the fish. Instead, general knowledge of spawning times in the region (mid-late May through at least mid-June) and movements during this time period were used to try to illustrate spawning distribution. Peak spawning periods were chosen based on net movement, but at the same time recognized that all radiotagged fish did not spawn during this period. The chosen periods are thought to best represent the majority of the spawning areas important to rainbow trout in the Kanektok River.

Insight into spawning behavior can be more easily assessed when studies span consecutive spawning seasons. A mixture of spawning migrations during 2010 and 2011 were documented with many tagged fish migrating short distances from overwintering areas to suspected spawning areas each year. A few fish (<5) exhibited substantial migrations to putative spawning areas during the first year but not the second year. This behavior suggests that some fish do not display fidelity to spawning areas or that some fish skip spawn (i.e., do not spawn in consecutive years). Skip spawning is difficult to assess, but it has been documented in the Naknek River (Schwanke 2009).

Lastly, this study provides useful information for designing future telemetric studies of riverine rainbow trout in the Kanektok River and possibly other watersheds in the region. The intensity of surveys flown in this study allowed us to document movements within a season and provide useful information to evaluate past, present, or future stock assessment programs (e.g., mark-recapture studies and length frequency comparisons within a specific river reach). If the objectives are reduced to document only fish distribution during each of the main seasons (summer, winter, and spring) the number of surveys could be reduced by targeting the desired time periods. Multiple surveys would still be needed during the presumed spawning period to better assess when, where, and how long rainbow trout spawn.

RECOMMENDATIONS

- Future study designs to assess rainbow trout in the Kanektok River watershed should consider differential seasonal distributions of rainbow trout observed among lower, middle, and upper summering fish.
- A spatial and temporal stratified creel survey of the sport fishery would help identify the level of effort, and when, where, and which groups of summering rainbow trout are being targeted and at what level of effort.
- The comparisons of rainbow trout size distributions between earlier studies (Wagner 1991; Adams 1996; Larson 2008) appears to have occurred in an acceptable time period and study reach where we found fish to move very little, especially during the summer period.
- Short-term studies assessing length frequencies of rainbow trout in specific river sections would be a useful and acceptable tool to describe present day population length structures (these areas would optimally overlap with areas of highest sport and subsistence uses). These could be used to detect changes in population structure over specified time intervals provided a representative sample can be taken.
- Genetic sampling should occur for spawning groups separated by the greatest distance (e.g., lower river spawning groups vs. spawning groups found below Kagati Lake) to determine if distinct populations of rainbow trout exist in the Kanektok River.
- If warranted, an abundance estimate using mark-recapture techniques could be accomplished during summer periods for specific sections of the Kanektok River as opposed to the entire drainage reach.
- One final pertinent observation is that these rainbow trout typically remained in their summertime distribution throughout the month of October. This is useful information if a mark-recapture study is ever conducted because it allows the option of having the second sample to be taken later in fall to better allow for localized mixing while still maintaining the assumption of population closure.

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FIGURES AND TABLES

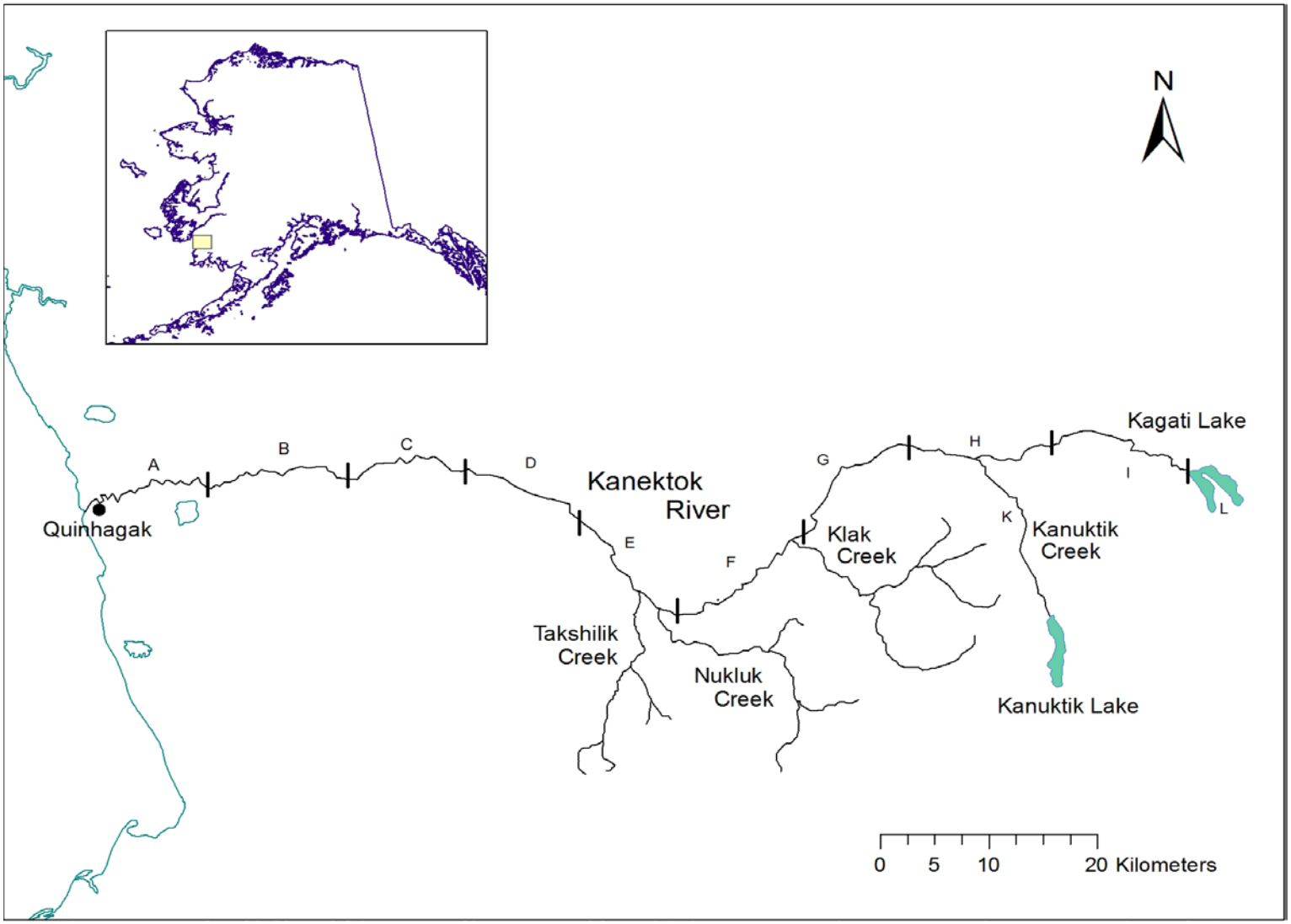

Figure 1.–Map of the Kanektok River with study section boundaries.

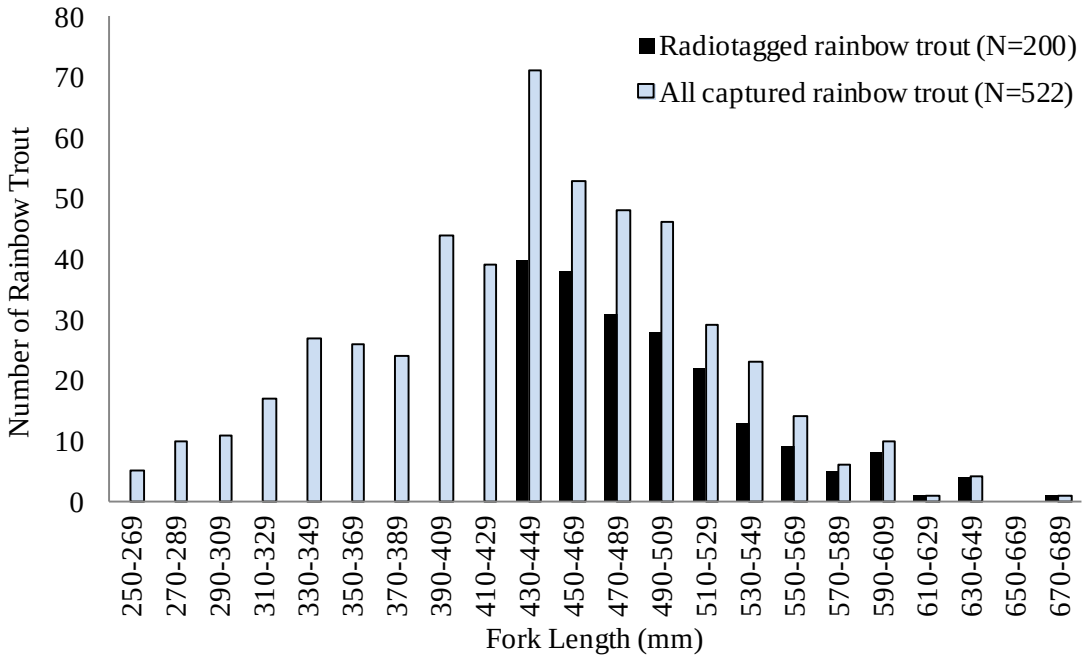

Figure 2.–Length histogram of rainbow trout caught and radiotagged in the Kanektok River, 3–12 August 2009.

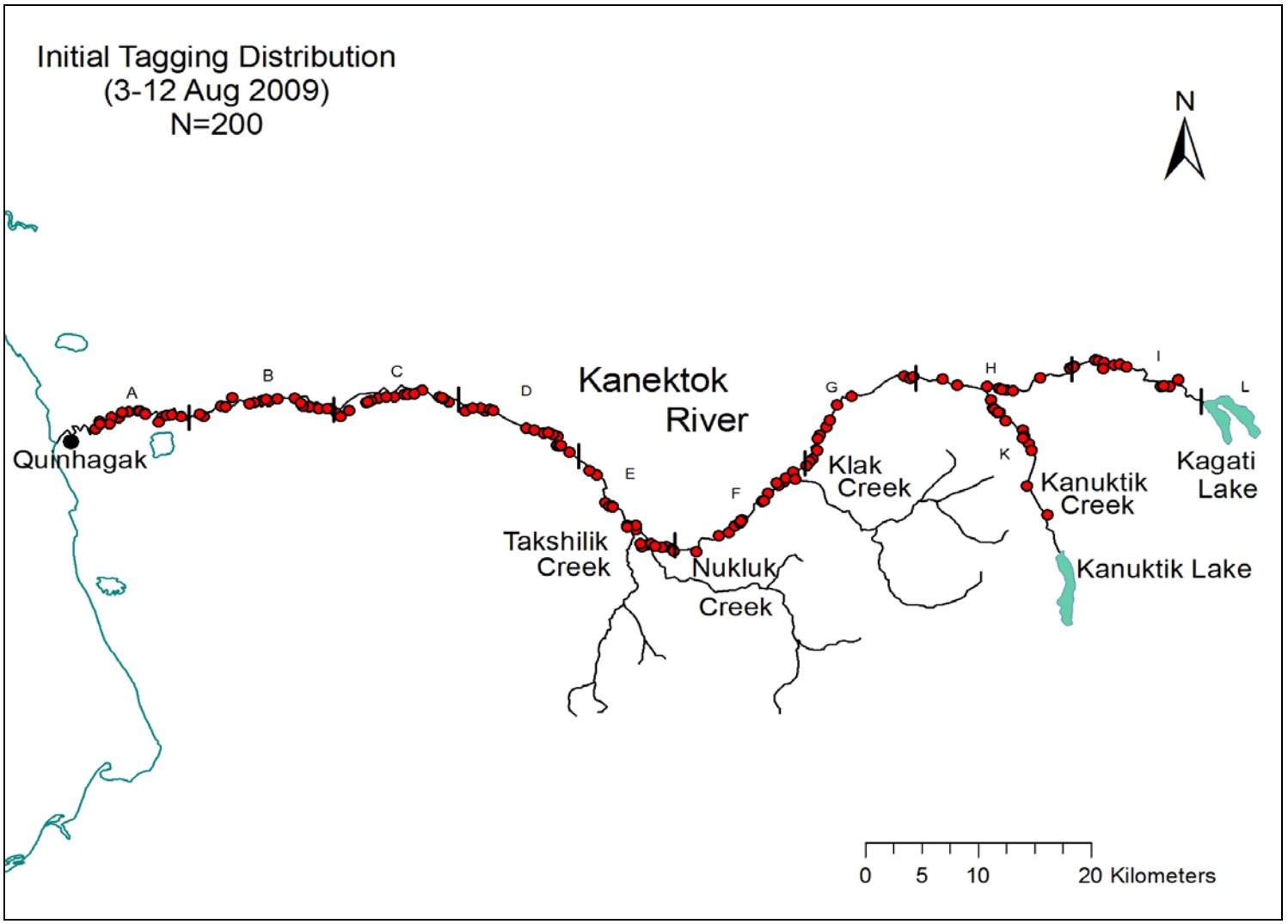

Figure 3.–Initial locations of 200 radiotagged rainbow trout from 3–12 August 2009. Each dot may represent more than one fish.

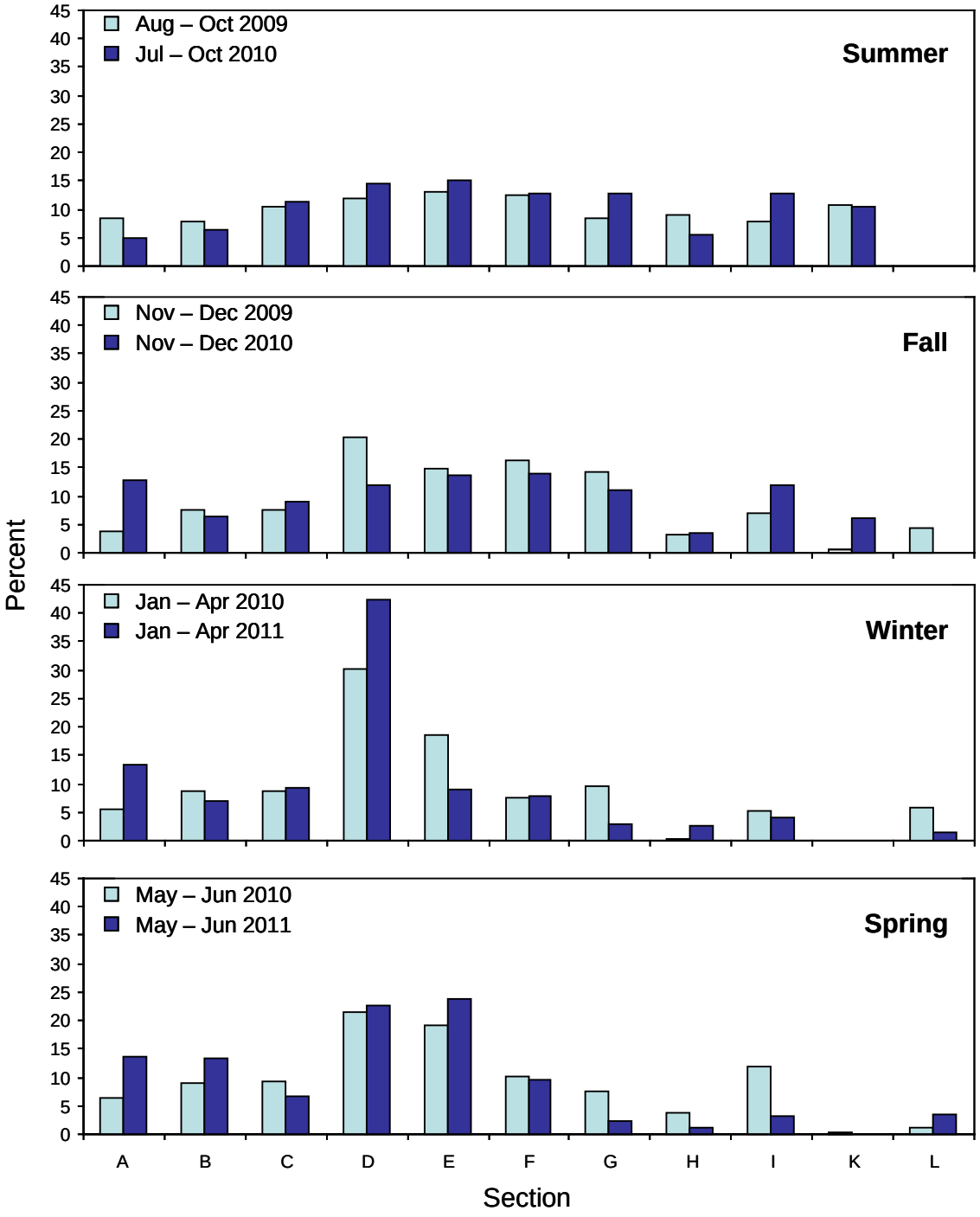

Figure 4.–Percent distribution of radiotagged rainbow trout by river sections A–I, Kanuktik Creek (K), and Kagati Lake (L) in the Kanektok River watershed during summer, fall, winter, and spring seasons, 2009–2011. Two surveys, 5 July and 6 October 2010, were omitted from the analysis due to incomplete surveys.

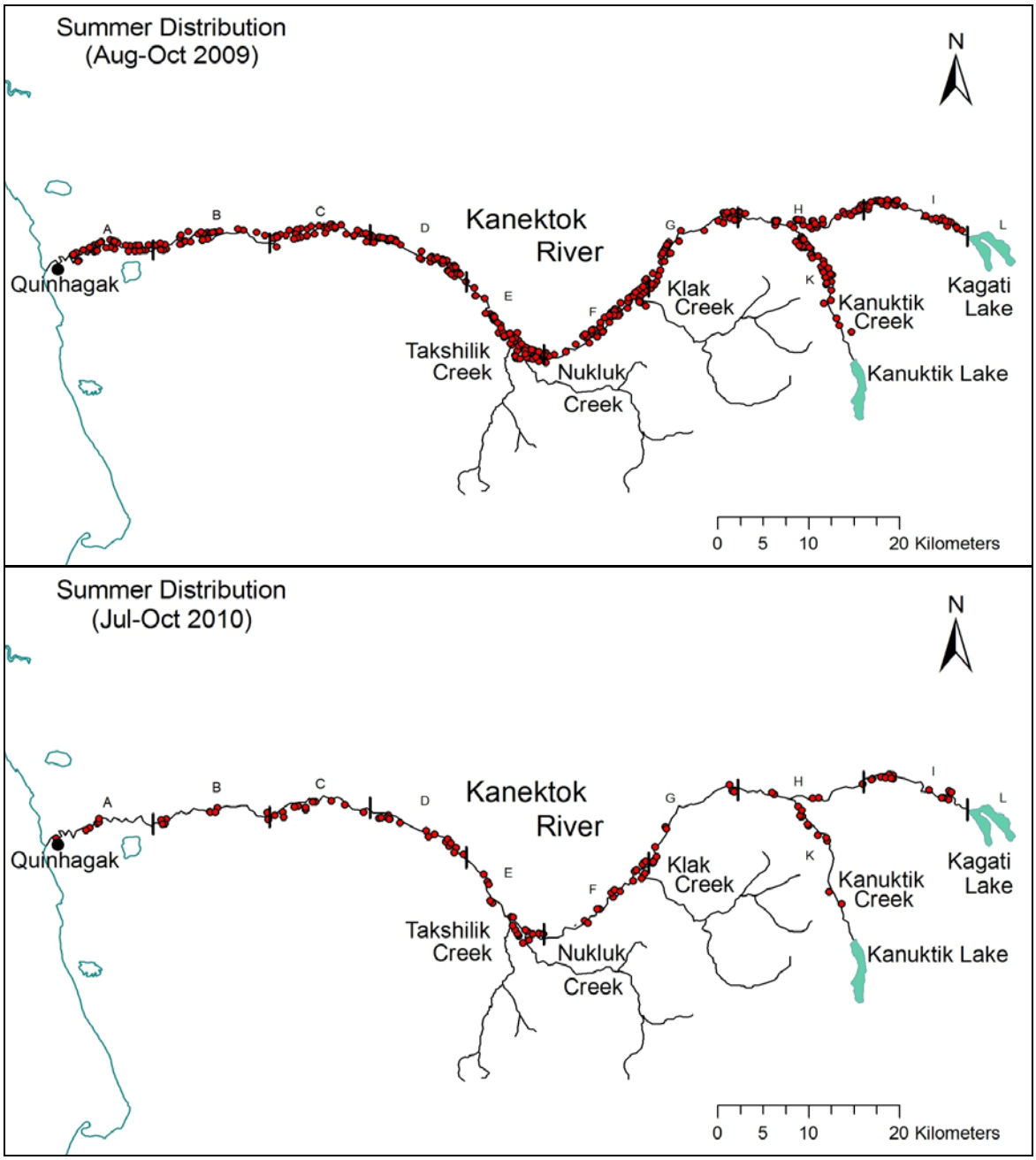

Figure 5.–Distribution of radiotagged rainbow trout during the summer seasons, Kanektok River, 2009–2010.

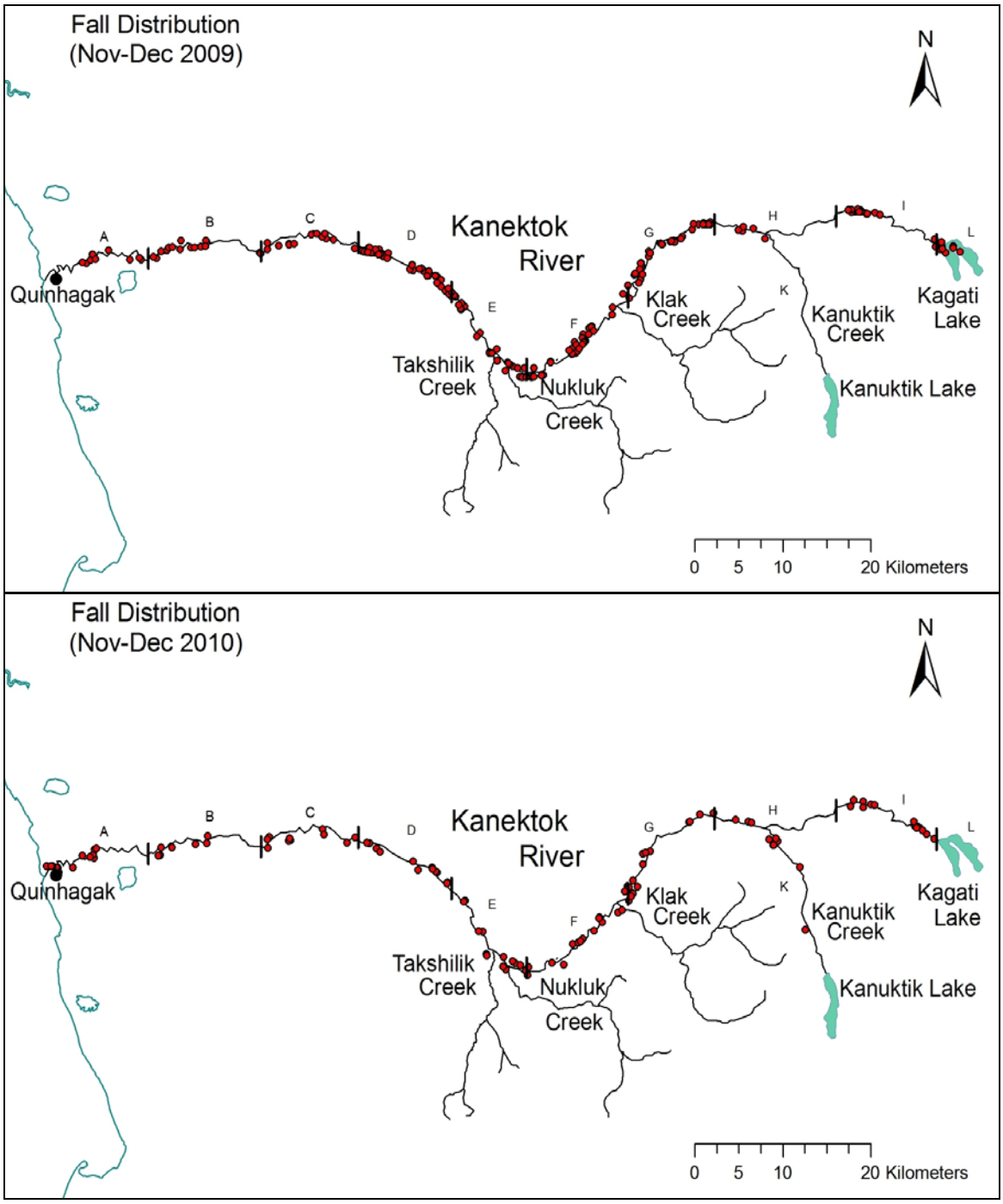

Figure 6.–Distribution of radiotagged rainbow trout during the fall seasons, Kanektok River, 2009–2010.

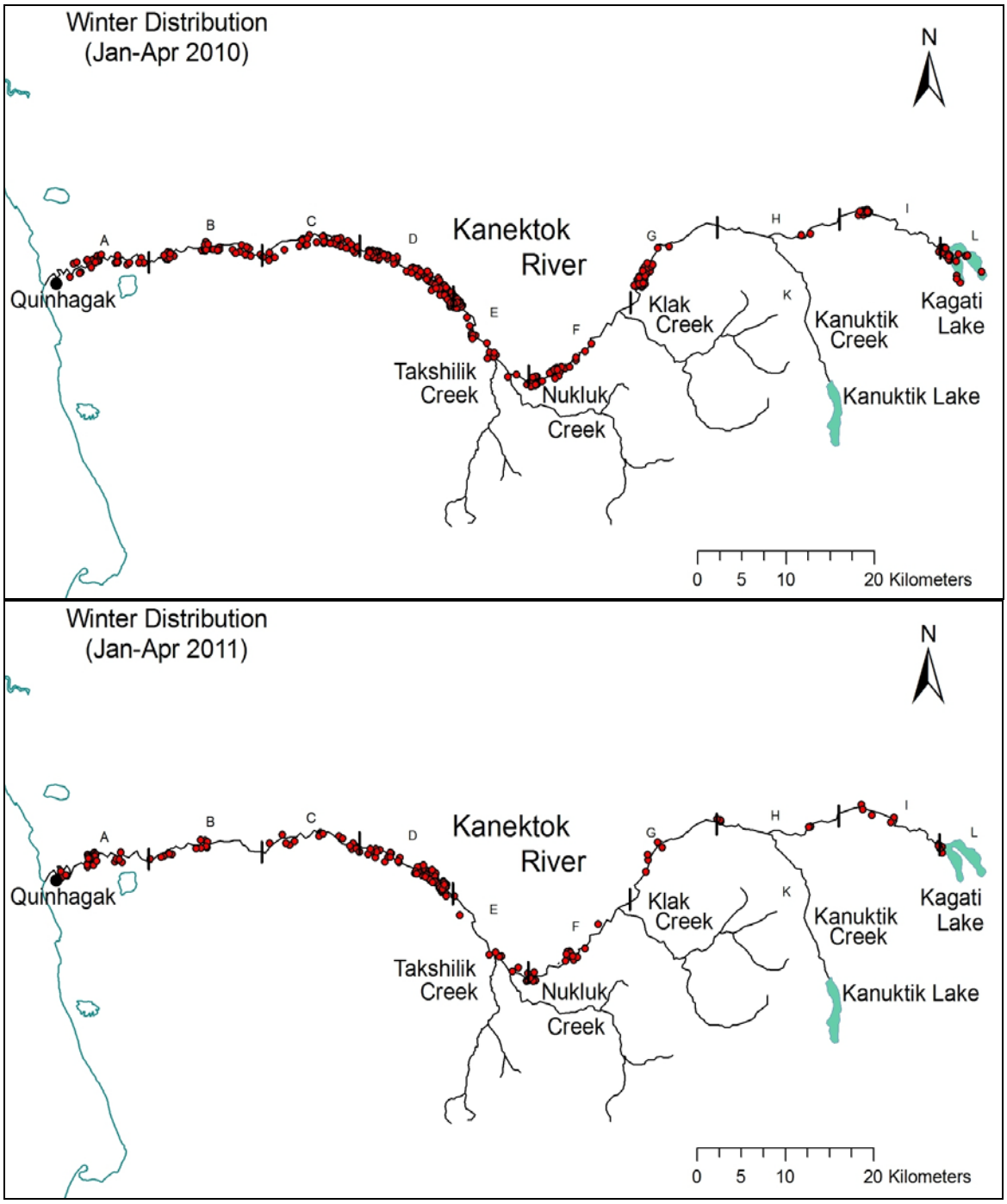

Figure 7.–Distribution of radiotagged rainbow trout during the winter seasons, Kanektok River, 2010–2011.

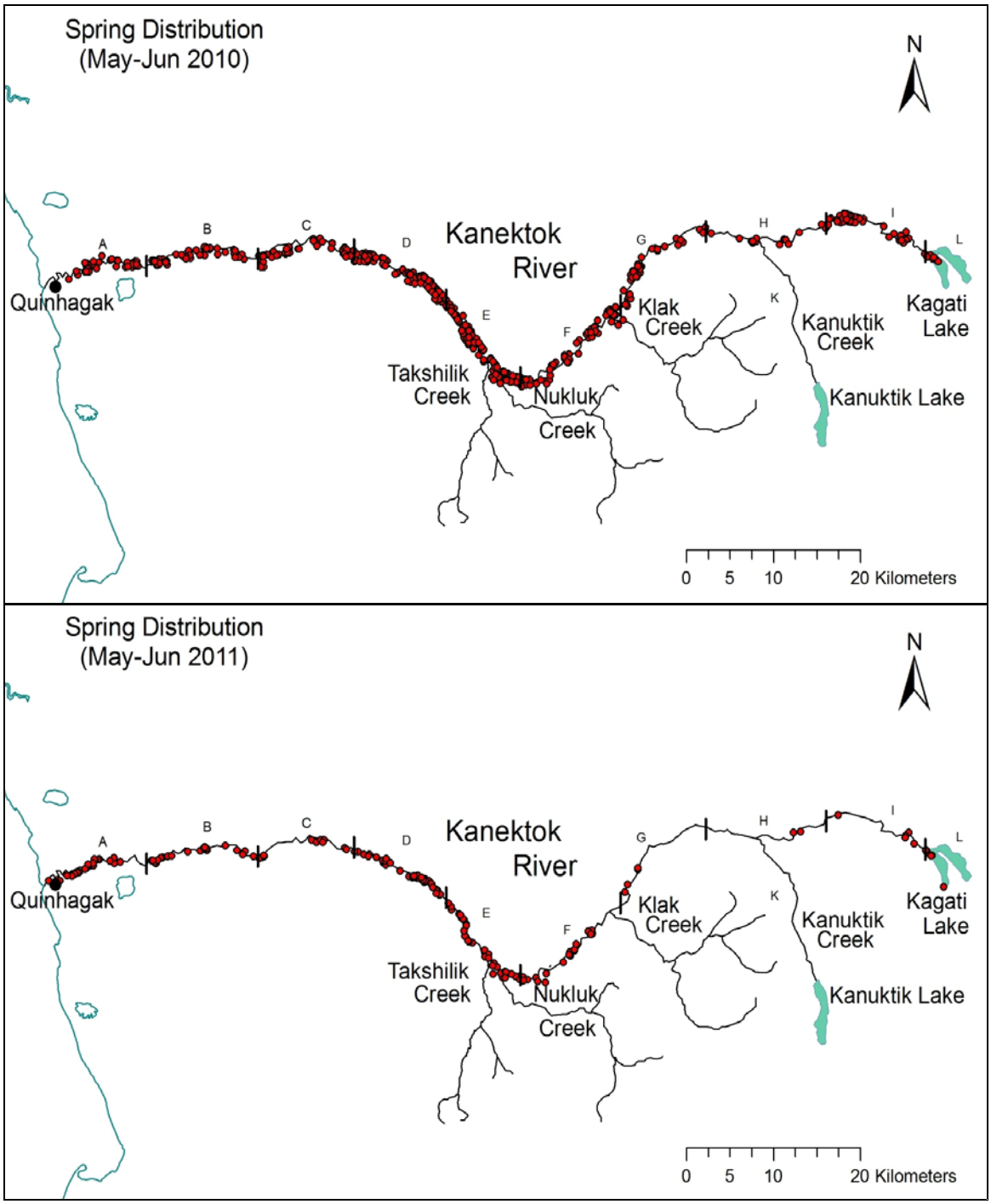

Figure 8.–Distribution of radiotagged rainbow trout during the spring seasons, Kanektok River, 2010–2011.

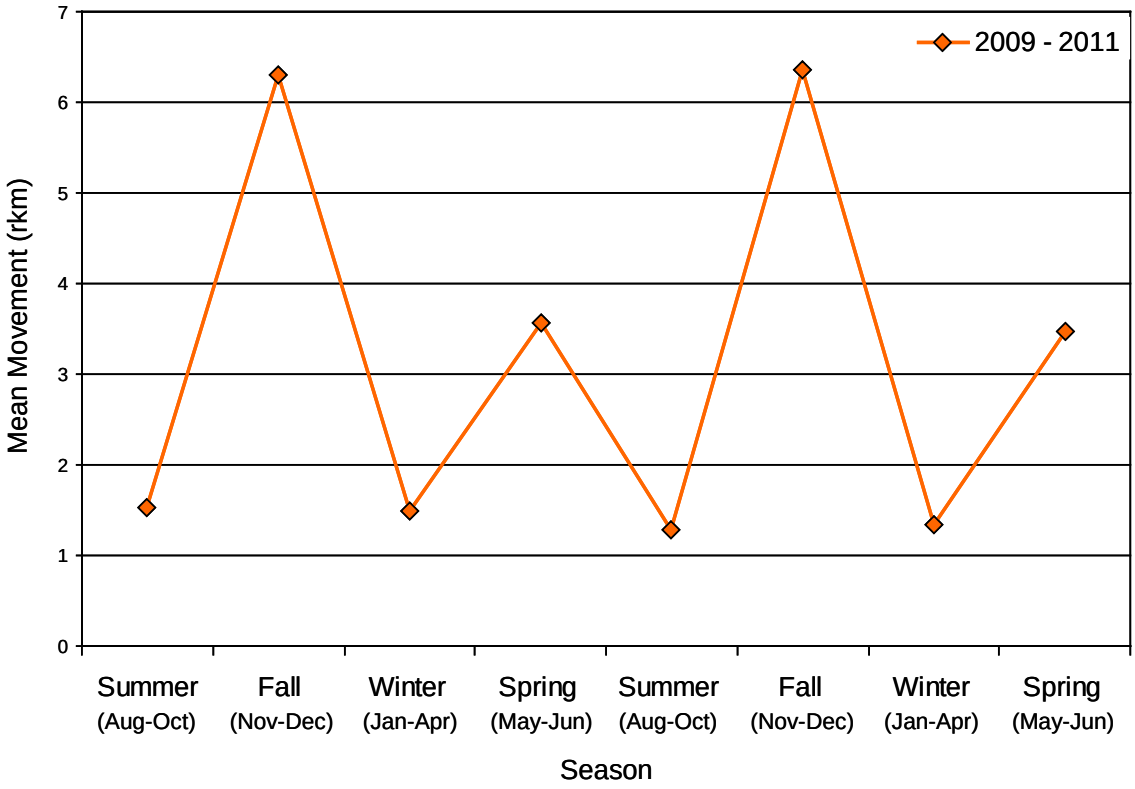

Figure 9.–Mean movement of radiotagged rainbow trout in the Kanektok River watershed during designated seasons from August 2009 to June 2011. Movement information collected from consecutive survey data within each season was used to determine mean movement.

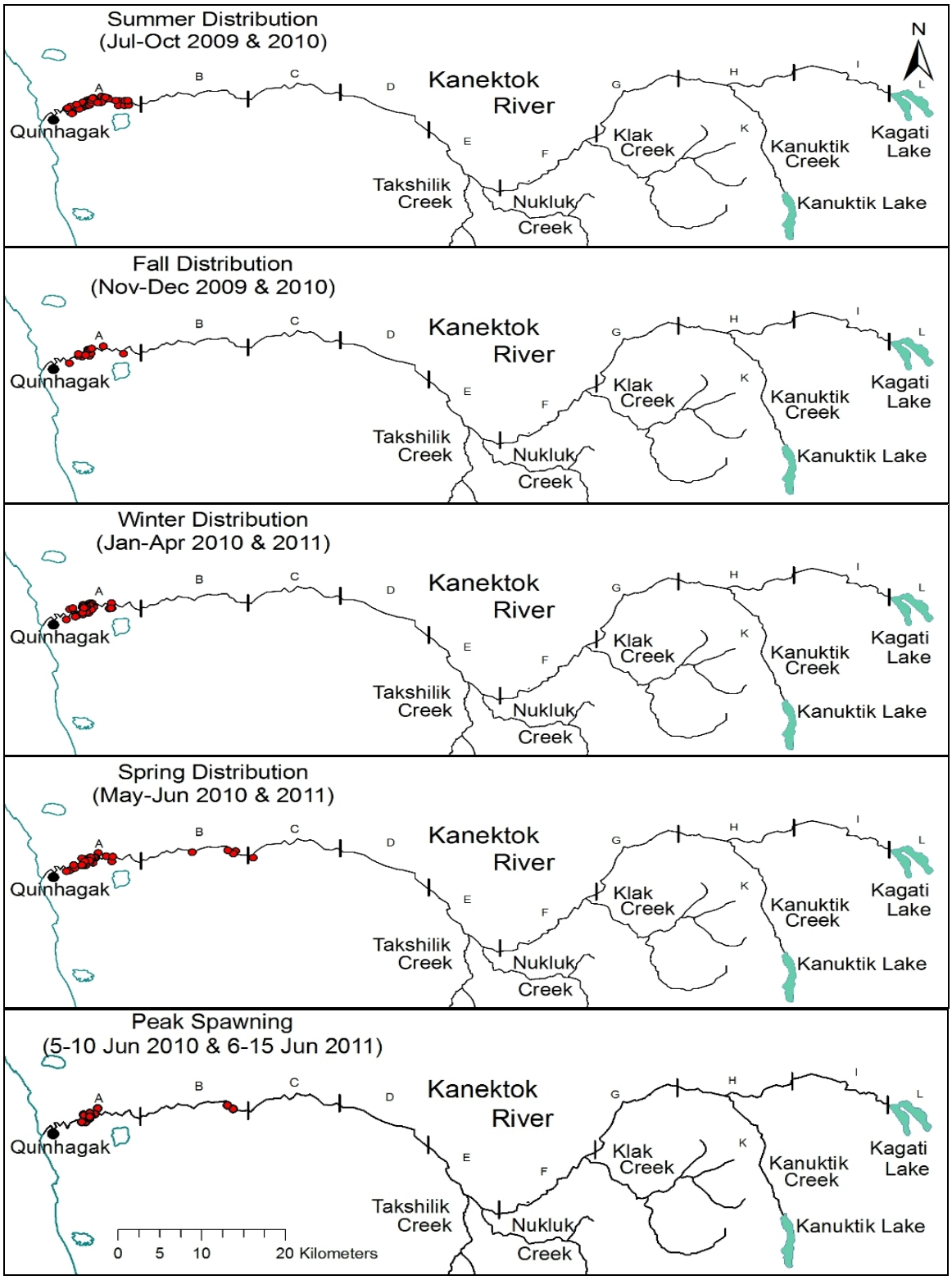

Figure 10.–Seasonal and peak spawning locations of rainbow trout originally radiotagged in section A, Kanektok River, 2009–2011.

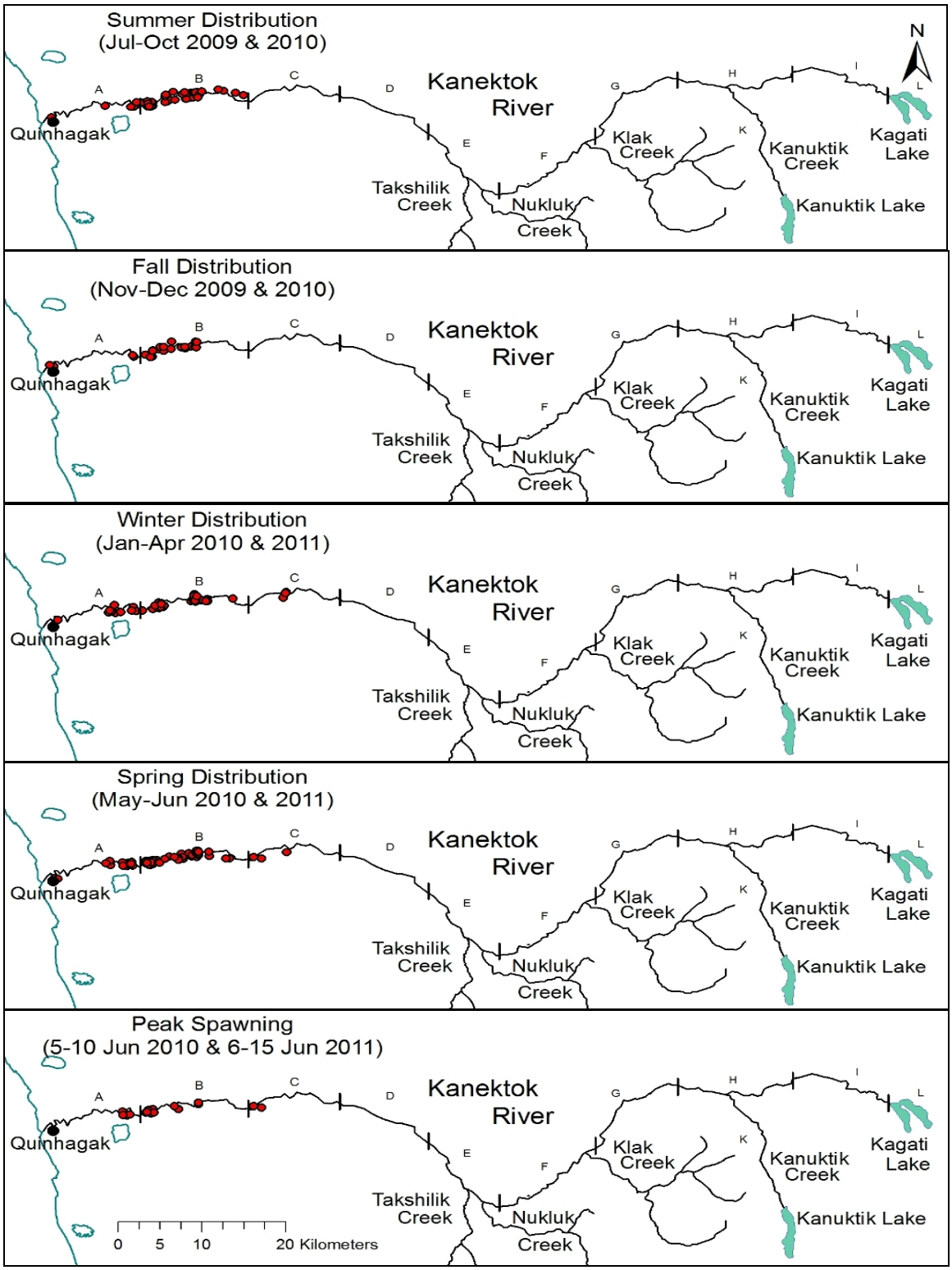

Figure 11.–Seasonal and peak spawning locations of rainbow trout originally radiotagged in section B, Kanektok River, 2009–2011.

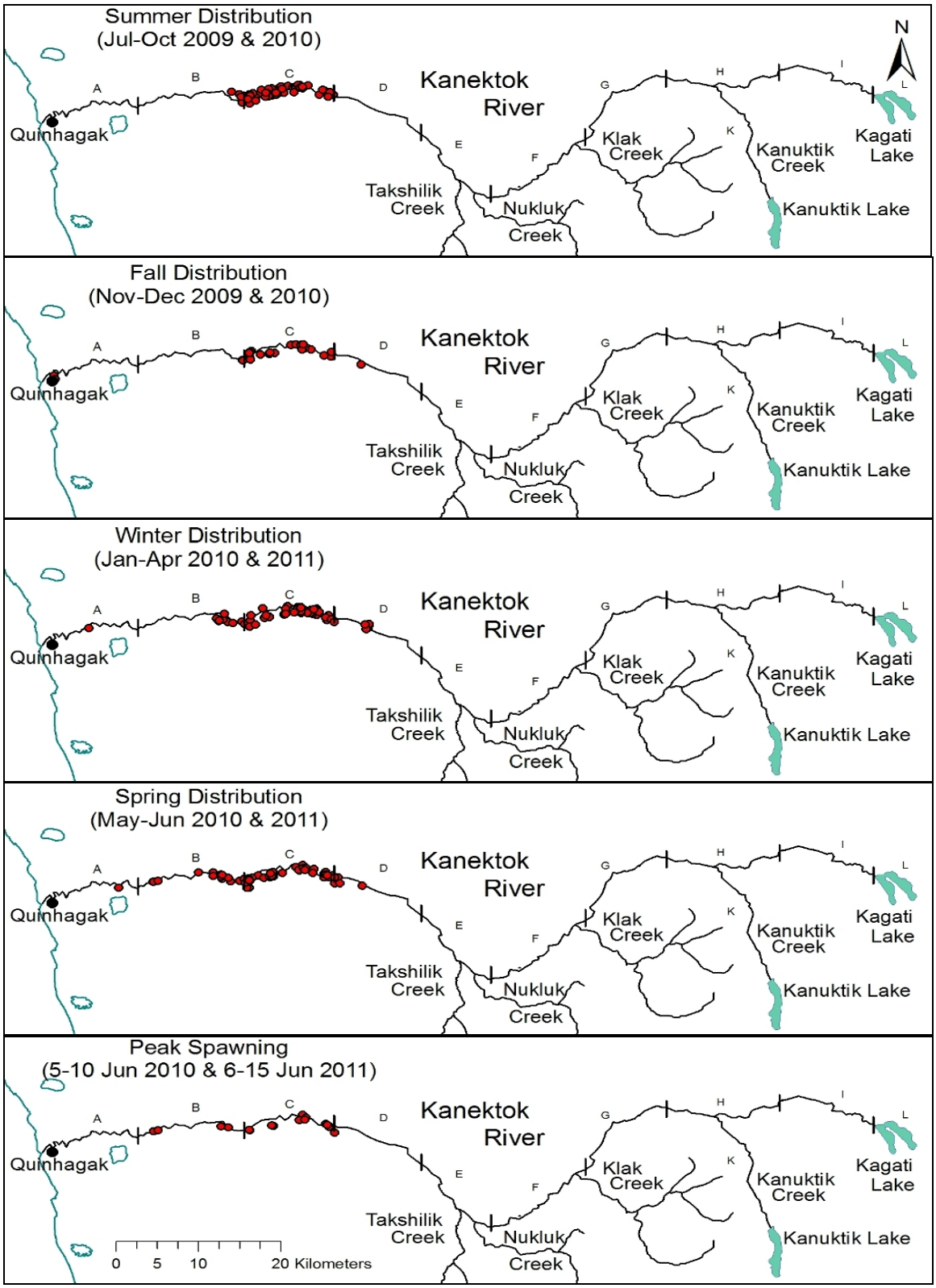

Figure 12.–Seasonal and peak spawning locations of rainbow trout originally radiotagged in section C, Kanektok River, 2009–2011.

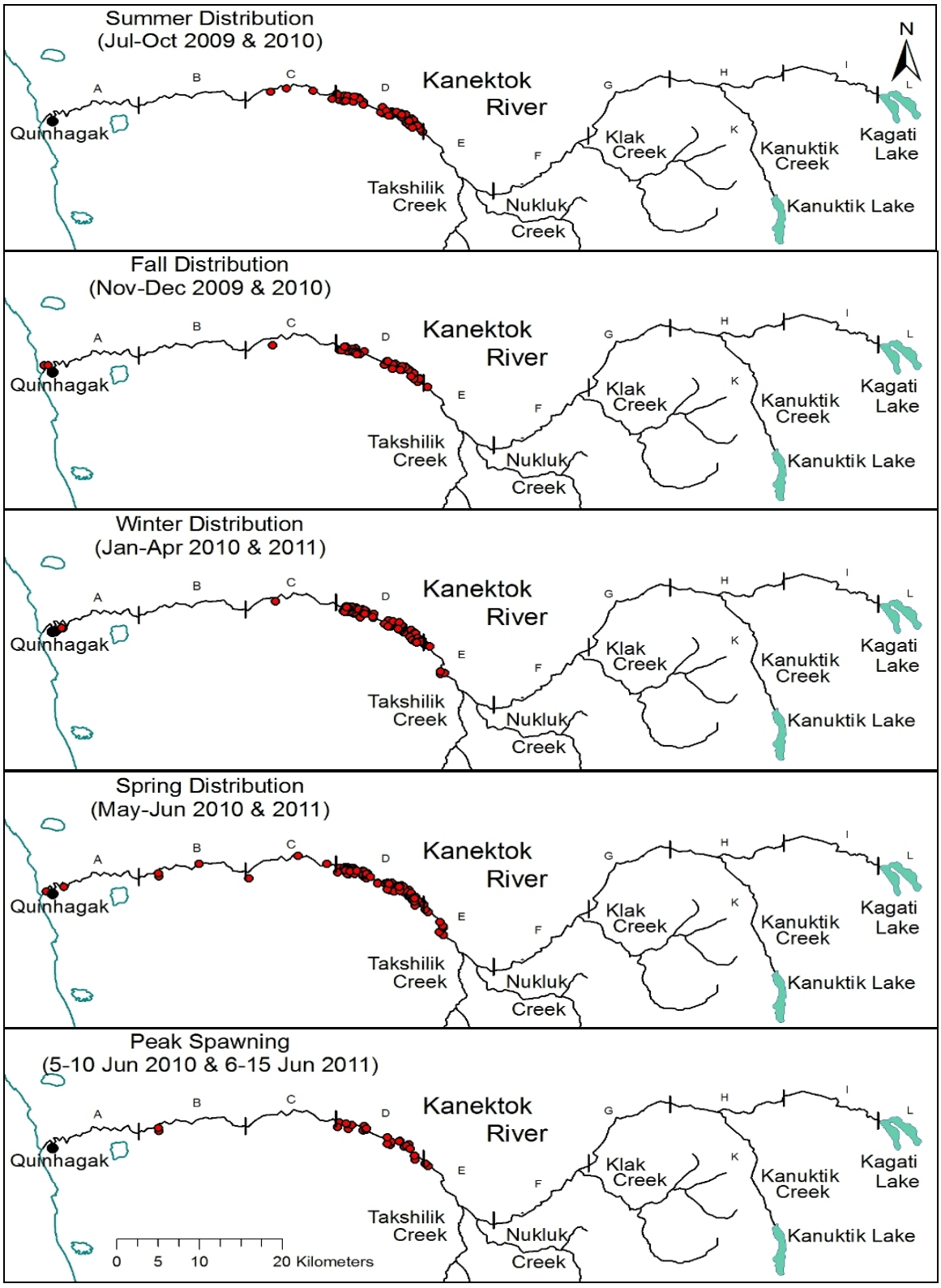

Figure 13.–Seasonal and peak spawning locations of rainbow trout originally radiotagged in section D, Kanektok River, 2009–2011.

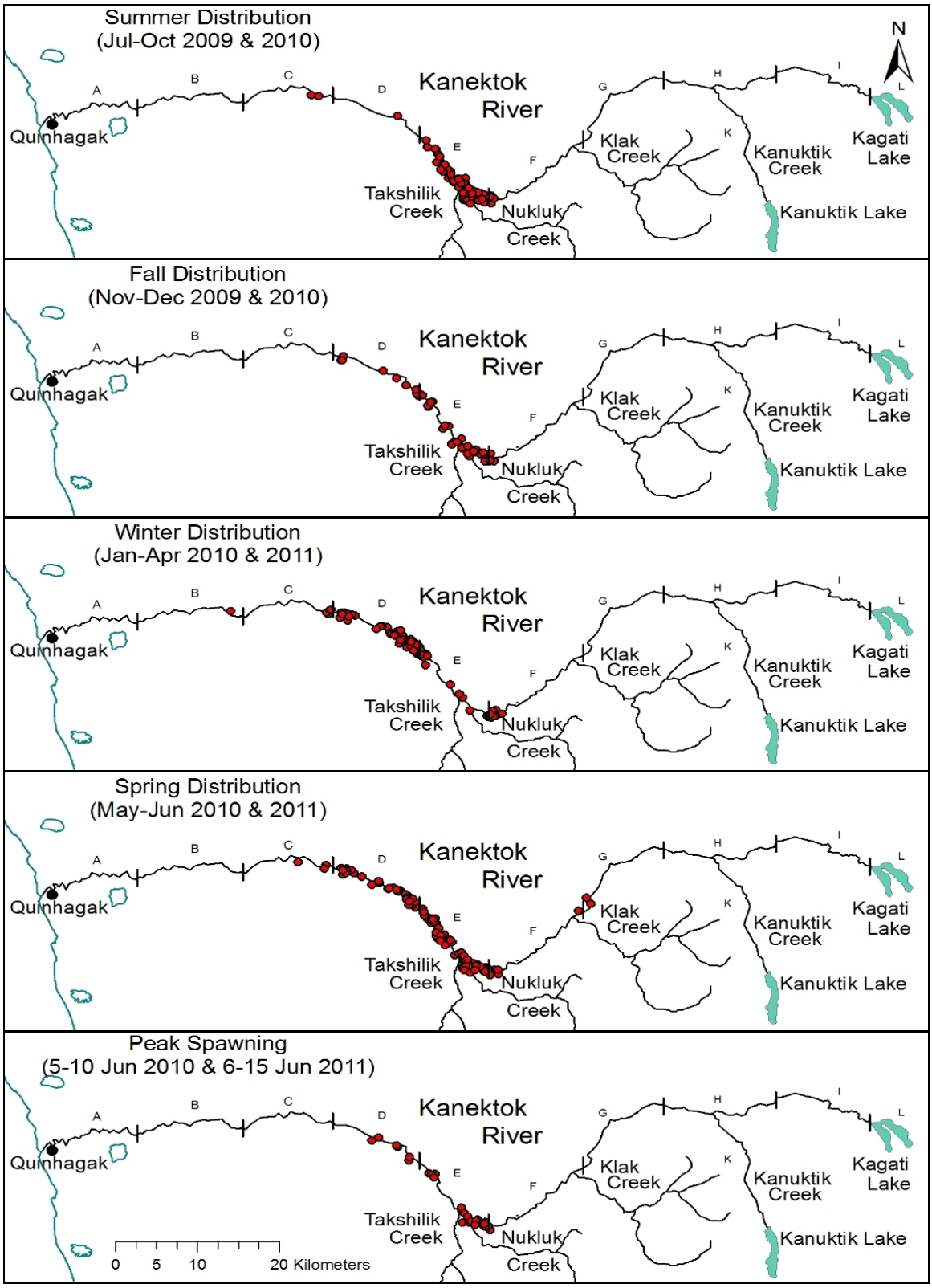

Figure 14.–Seasonal and peak spawning locations of rainbow trout originally radiotagged in section E, Kanektok River, 2009–2011.

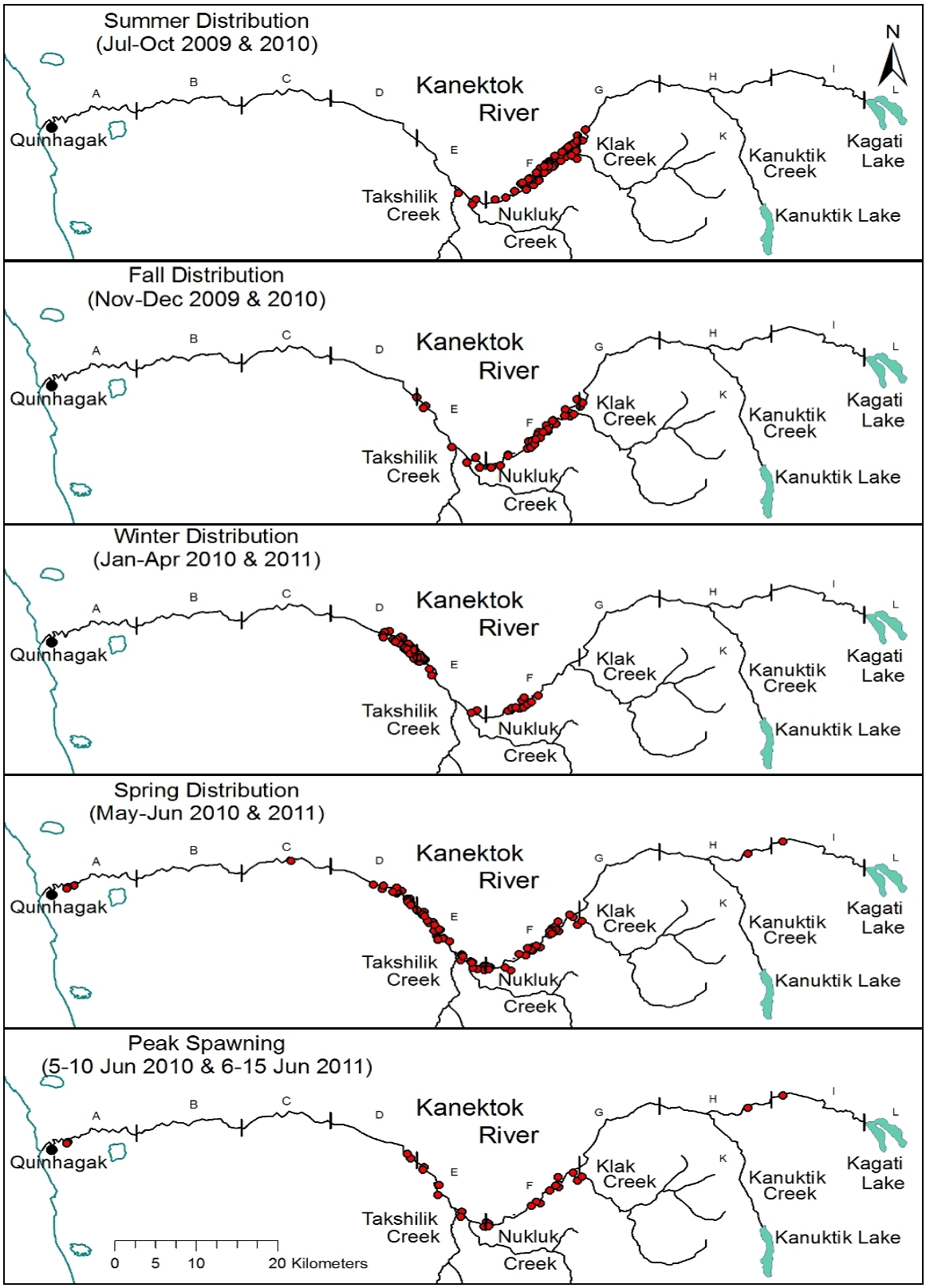

Figure 15.–Seasonal and peak spawning locations of rainbow trout originally radiotagged in section F, Kanektok River, 2009–2011.

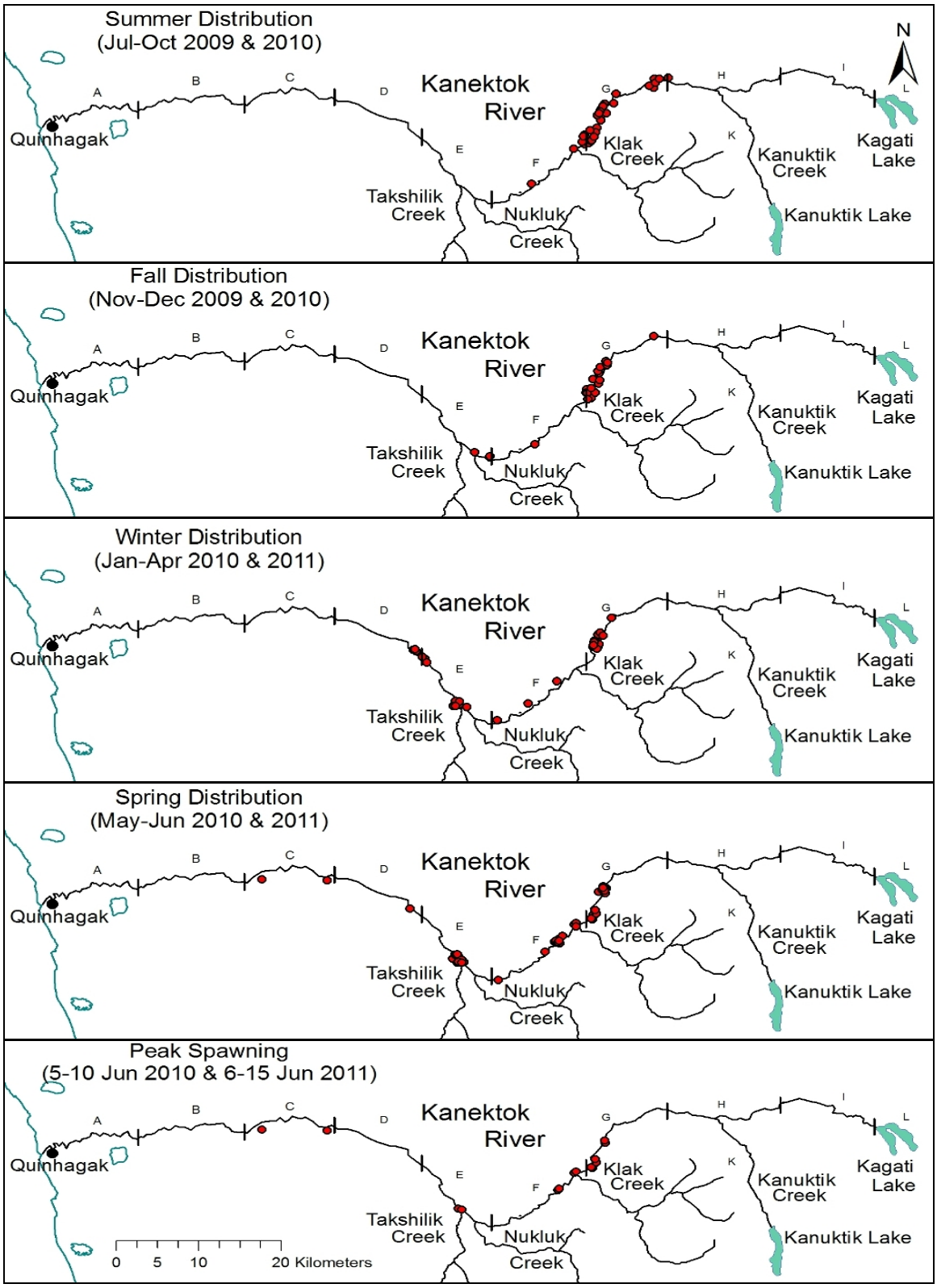

Figure 16.–Seasonal and peak spawning locations of rainbow trout originally radiotagged in section G, Kanektok River, 2009–2011.

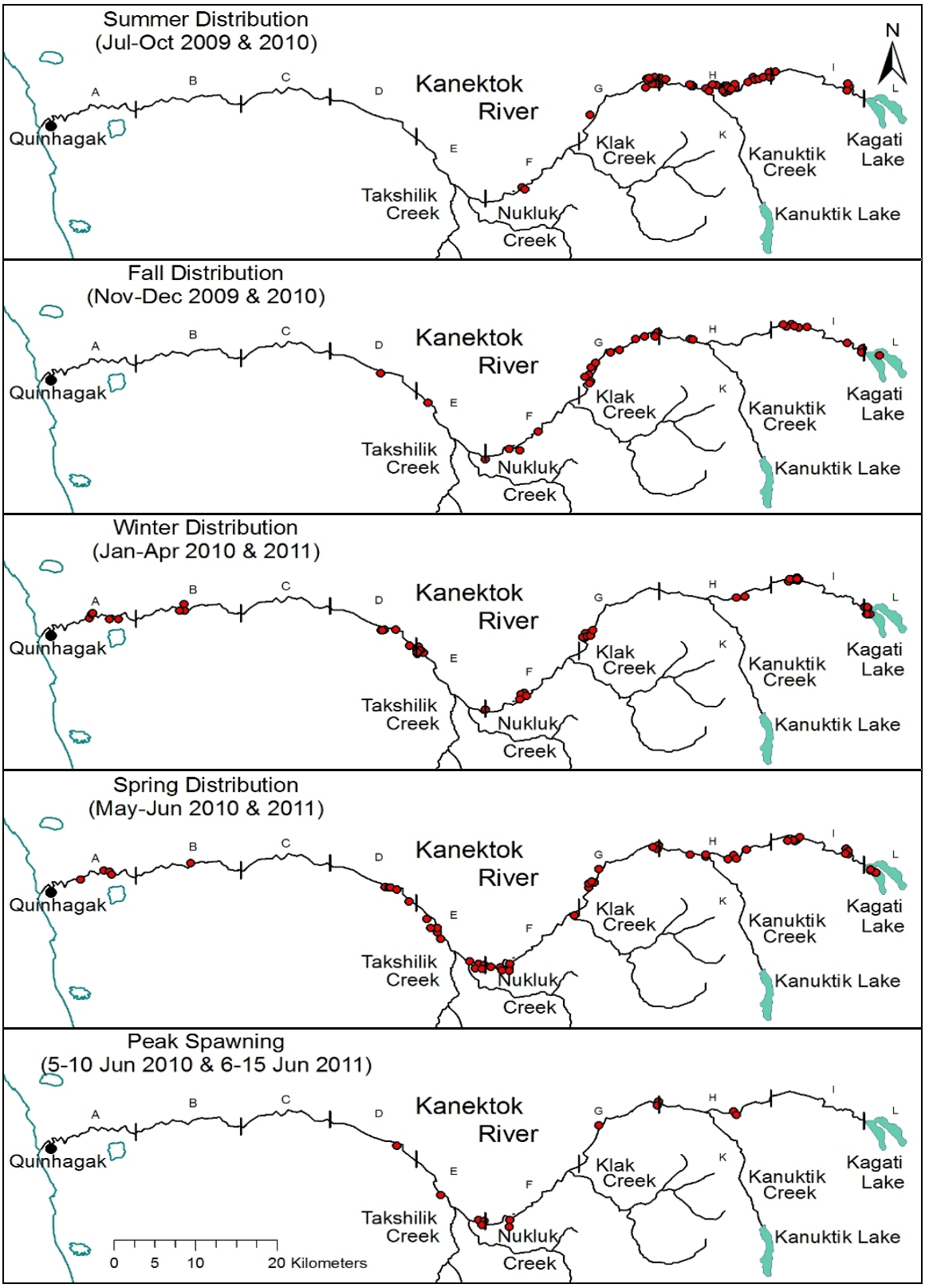

Figure 17.–Seasonal and peak spawning locations of rainbow trout originally radiotagged in section H, Kanektok River, 2009–2011.

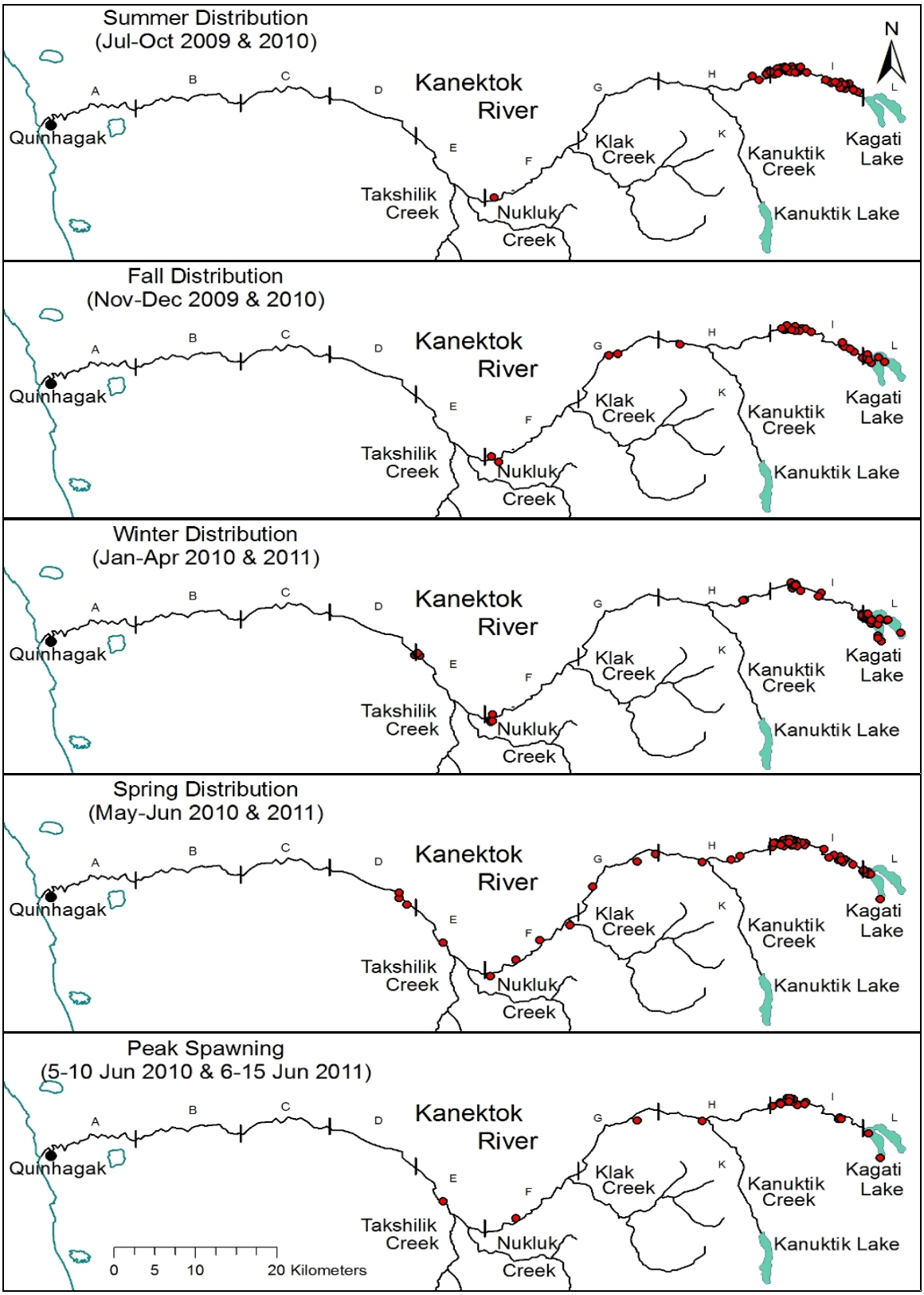

Figure 18.–Seasonal and peak spawning locations of rainbow trout originally radiotagged in section I, Kanektok River, 2009–2011.

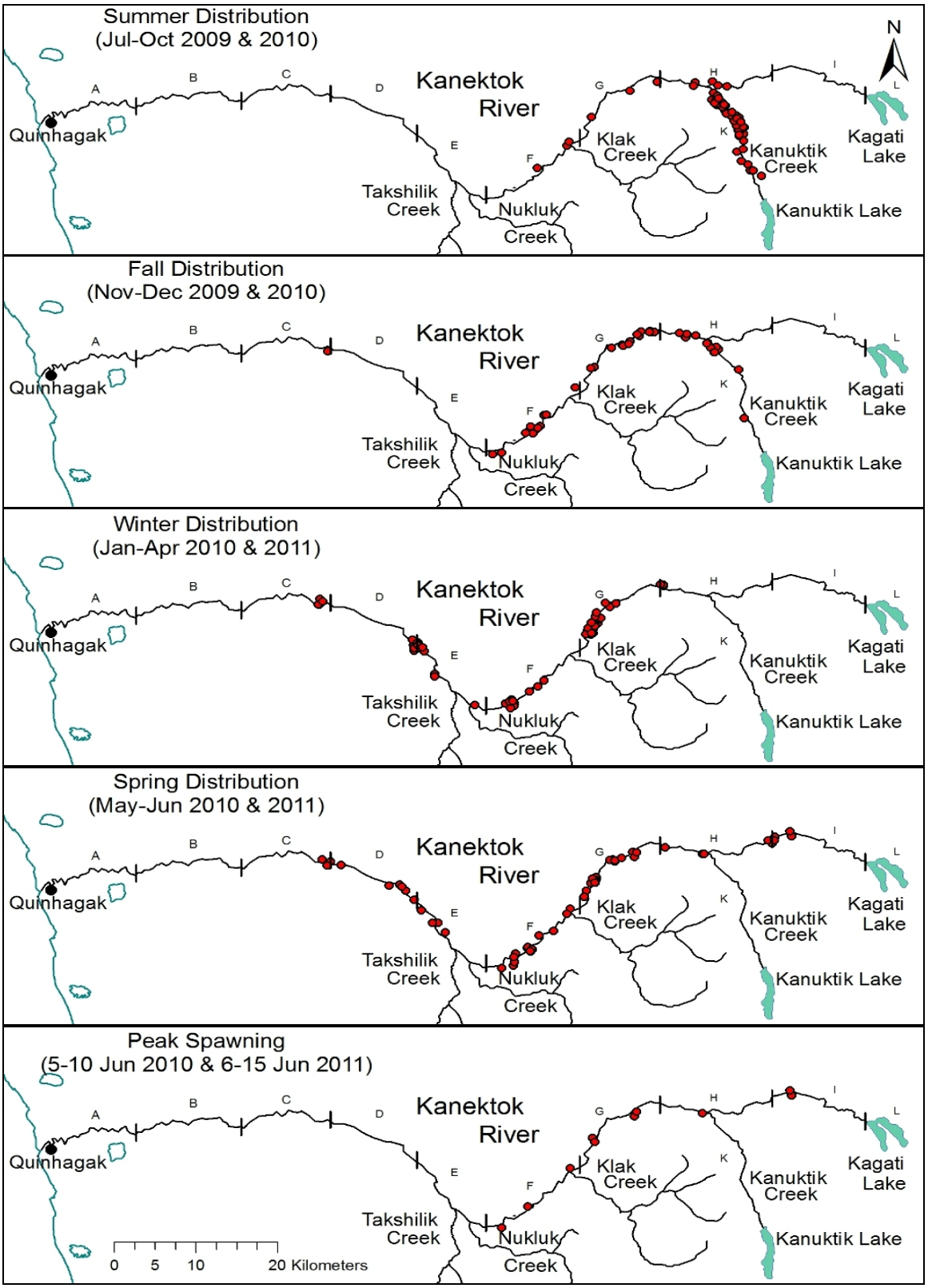

Figure 19.–Seasonal and peak spawning locations of rainbow trout originally radiotagged in section K, Kanektok River, 2009–2011.

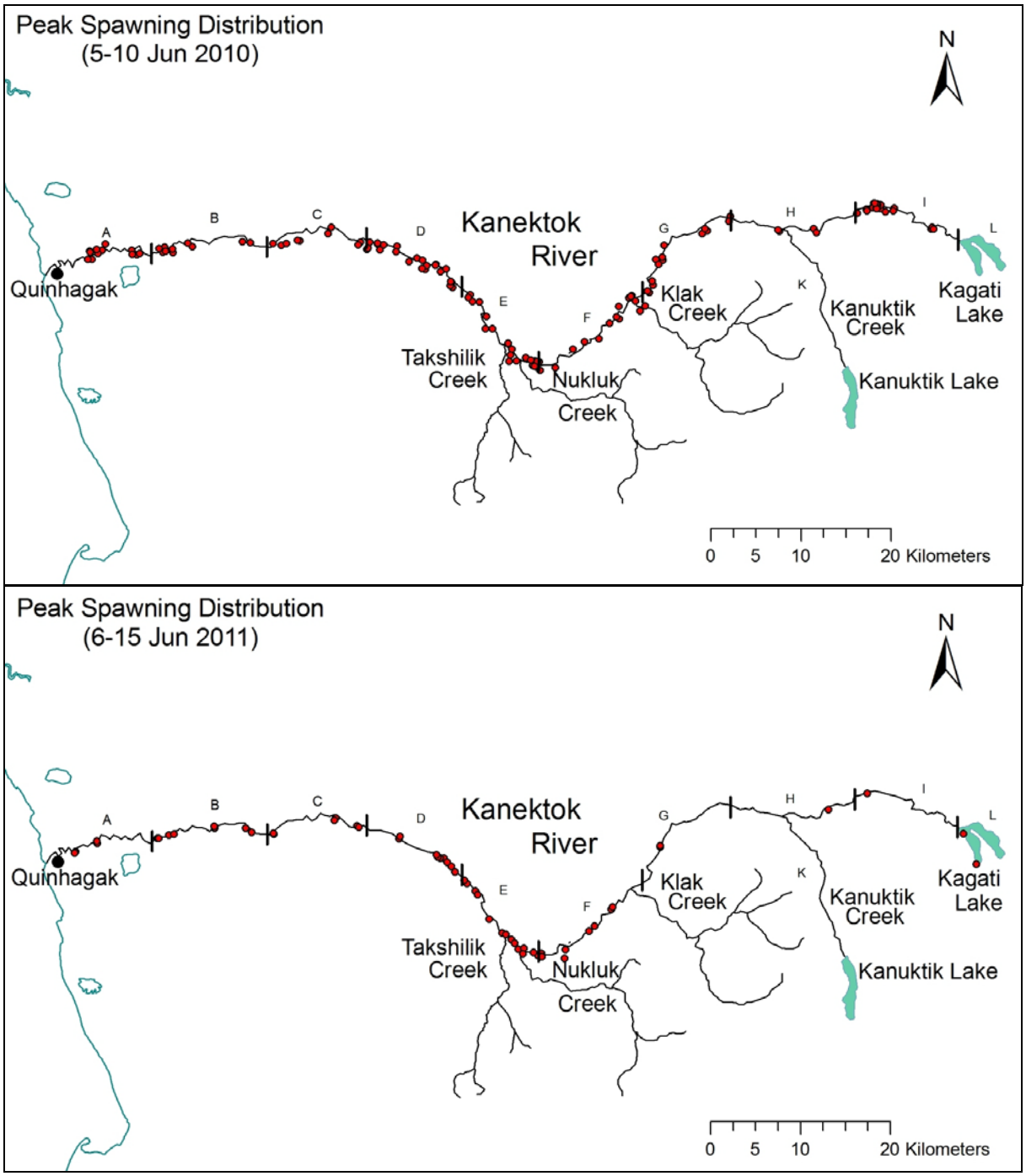

Figure 20.–Distribution of radiotagged rainbow trout during the peak spawning period, Kanektok River, 2010–2011.

Table 1.–Sport angler harvest and catch of rainbow trout, and angler effort for all species in the Kanektok River, 1983–2010.

Year	Effort[a](angler days)	Harvest	Catch
1983	1,517	640	
1984	6,881	312	
1985	4,630	156	
1986	8,825	259	
1987	9,689	132	
1988	12,697	400	
1989	4,176	126	
1990	4,525	281	7,810
1991	3,078	182	5,856
1992	4,972	55	1,496
1993	3,791	130	4,106
1994	6,505	59	4,779
1995	5,512	198	3,046
1996	4,812	133	6,704
1997	9,706	231	27,518
1998	8,114	0	13,567
1999	8,194	73	11,151
2000	7,231	0	6,019
2001	9,063	0	7,984
2002	5,885	0	8,846
2003	7,655	0	8,455
2004	6,364	68	8,525
2005	5,789	0	7,070
2006	7,826	0	11,793
2007	5,071	11	11,538
2008	8,024	0	16,375
2009	3,267	0	12,670
2010	5,307	17	10,263
Average			
2001–2005	6,951	14	8,176
2006–2010	5,899	6	12,528

Source Data from Mills (1984-1994); Howe et al. (1995, 1996, 2001a-d); Walker et al. (2003); Jennings et al. (2004, 2006a-b, 2007, 2009a-b, 2010a-b, 2011a-b).

[a] Effort is for all species

Table 2.–Mean fork length of radiotagged and all captured rainbow trout in the Kanektok River during August 2009.

	Radiotagged fish ≥430 mm FL					All fish				
		Fork length (mm)					Fork length (mm)			
Section	N	Mean	SD	Min.	Max.	N	Mean	SD	Min.	Max.
A	20	525.4	51.6	444	635	43	487.3	76.0	305	635
B	20	477.3	36.4	432	563	91	436.5	69.1	231	600
C	20	460.4	36.4	430	587	94	388.0	75.1	135	587
D	19	452.2	19.3	430	496	51	406.6	63.3	162	500
E	26	476.7	28.7	430	528	77	439.2	60.3	280	573
F	23	503.3	44.4	435	604	36	470.6	70.4	309	604
G	14	495.0	51.4	445	633	30	432.7	95.0	245	633
H	18	492.1	33.6	430	542	36	437.7	76.5	242	542
I	20	532.9	68.1	431	680	41	427.8	135.5	177	680
K	20	521.9	58.9	437	603	23	507.3	66.9	393	603
Total	200	493.5	50.9	430	680	522	434.1	84.1	135	680

Table 3.–Planned and actual deployment of radio tags in the Kanektok River, 2009.

Section	Planned Deployment	Actual Deployment
A	20	20
B	20	20
C	20	20
D	20	19
[a]E	20	26
[b]F	20	23
G	20	14
H	20	18
I	20	20
K	20	20

[a] Section E includes tags deployed in Nukluk (n=3) and Takshilik (n=3) creeks.

[b] Section F includes tags deployed in Klak Creek (n=3)

Table 4.–Aerial tracking dates and the number of radiotagged rainbow trout by status category, Kanektok River, 2009–2011.

Survey number	Survey date	Number of fish		
		Alive	Dead	Missing
1	8/16/2009	185	7	8
2	9/23/2009	92	48	60
3	10/3/2009	99	47	54
4	10/26/2009	118	53	29
5	11/17/2009	112	58	30
6	12/23/2009	97	63	40
7	1/21/2010	80	66	54
8	2/11/2010	93	77	30
9	3/19/2010	89	77	33
10	4/9/2010	87	80	33
11	4/27/2010	85	82	33
12	5/3/2010	82	80	38
13	5/12/2010	72	74	54
14	5/18/2010	67	75	58
15	5/24/2010	80	78	42
16	6/5/2010	85	82	33
17	6/10/2010	68	74	58
18	6/21/2010	63	78	59
19 [a]	7/5/2010	17	16	167
20	7/22/2010	63	82	55
21	8/18/2010	62	85	53
22 [a]	10/6/2010	52	85	63
23	11/3/2010	59	97	44
24	11/19/2010	51	95	54
25	1/6/2011	44	86	70
26	2/10/2011	44	99	57
27	3/15/2011	36	95	69
28	4/1/2011	30	95	75
29	4/13/2011	29	89	82
30	5/2/2011	39	101	60
31	5/11/2011	42	104	54
32	5/27/2011	33	93	74
33	6/6/2011	31	103	66
34	6/15/2011	35	104	61
35 [a]	7/5/2011	23	74	103
36	8/10/2011	34	111	55

[a] Incomplete survey due to inclement weather.

Table 5.–The percentage of rainbow trout radiotagged in each river section, and subsequent percentages of rainbow trout found in each river section by survey date, Kanektok River, 2009–2011.

	Section											
Date	A	B	C	D	E	F	G	H	I	K	[a]L	# Fish
8/3-8/12/2009	10.0	10.0	10.0	9.5	13.0	11.5	7.0	9.0	10.0	10.0	0	200
8/16/2009	10.9	9.8	11.4	9.8	12.0	9.8	7.1	8.7	10.9	9.8	0	184
9/23/2009	8.7	7.6	10.9	15.2	12.0	13.0	8.7	7.6	2.2	14.1	0	92
10/3/2009	7.1	6.1	11.1	10.1	14.1	14.1	11.1	13.1	9.1	4.0	0	99
10/26/2009	5.1	5.9	8.5	11.9	14.4	13.6	8.5	7.6	12.7	11.9	0	118
11/17/2009	5.4	7.1	7.1	17.0	13.4	15.2	16.1	5.4	8.9	0.9	3.6	112
12/23/2009	2.1	8.2	8.2	23.7	16.5	17.5	12.4	1.0	5.2	0	5.2	97
1/21/2010	3.8	8.8	8.8	26.3	21.3	7.5	12.5	0	7.5	0	3.8	80
2/11/2010	5.4	8.6	8.6	33.3	17.2	6.5	8.6	0	5.4	0	6.5	93
3/19/2010	5.6	7.9	7.9	30.3	18.0	9.0	9.0	1.1	4.5	0	6.7	89
4/9/2010	6.9	8.0	9.2	31.0	19.5	6.9	8.0	0	4.6	0	5.7	87
4/27/2010	7.1	10.6	9.4	30.6	15.3	7.1	8.2	1.2	3.5	0	7.1	85
5/3/2010	6.1	8.5	9.8	30.5	19.5	9.8	7.3	0	3.7	1.2	3.7	82
5/12/2010	6.9	11.1	11.1	20.8	23.6	12.5	6.9	1.4	4.2	0	1.4	72
5/18/2010	4.5	11.9	9.0	28.4	16.4	11.9	9.0	0	7.5	0	1.5	67
5/24/2010	2.5	8.8	5.0	25.0	23.8	8.8	8.8	2.5	12.5	0	2.5	80
6/5/2010	7.1	7.1	10.6	16.5	20.0	10.6	8.2	3.5	16.5	0	0	85
6/10/2010	8.8	7.4	7.4	17.6	16.2	10.3	8.8	5.9	17.6	0	0	68
6/21/2010	7.9	9.5	11.1	15.9	15.9	7.9	4.8	11.1	15.9	0	0	63
[b]7/5/2010	-	-	-	-	-	-	5.9	23.5	47.1	23.5	0	17
7/22/2010	4.8	6.3	11.1	14.3	12.7	14.3	6.3	6.3	12.7	11.1	0	63
8/18/2010	4.8	6.5	11.3	14.5	17.7	11.3	6.5	4.8	12.9	9.7	0	62
[b]10/6/2010	-	3.8	13.5	13.5	21.2	9.6	11.5	5.8	13.5	7.7	0	52
11/3/2010	11.9	6.8	10.2	11.9	13.6	11.9	8.5	5.1	11.9	8.5	0	59
11/19/2010	13.7	5.9	7.8	11.8	13.7	15.7	13.7	2.0	11.8	3.9	0	51
1/6/2011	11.4	4.5	11.4	31.8	18.2	9.1	4.5	2.3	4.5	0	2.3	44
2/10/2011	13.6	6.8	9.1	40.9	9.1	9.1	2.3	2.3	4.5	0	2.3	44
3/15/2011	11.1	8.3	8.3	47.2	5.6	8.3	2.8	2.8	5.6	0	0	36
4/1/2011	16.7	6.7	10.0	50.0	3.3	6.7	0	3.3	3.3	0	0	30
4/13/2011	17.2	10.3	6.9	48.3	3.4	3.4	3.4	3.4	0	0	3.4	29
5/2/2011	15.4	10.3	2.6	43.6	10.3	7.7	2.6	2.6	0	0	5.1	39
5/11/2011	19.0	9.5	7.1	26.2	19.0	9.5	2.4	0	0	0	7.1	42
5/27/2011	15.2	15.2	3.0	21.2	27.3	12.1	0	0	6.1	0	0	33
6/6/2011	12.9	16.1	9.7	16.1	25.8	9.7	3.2	3.2	0	0	3.2	31
6/15/2011	8.6	14.3	8.6	14.3	31.4	8.6	2.9	0	8.6	0	2.9	35
[b] 7/5/2011	17.4	4.3	8.7	8.7	26.1	8.7	4.3	8.7	8.7	0	4.3	23
8/10/2011	11.8	8.8	8.8	8.8	23.5	11.8	2.9	5.9	8.8	5.9	2.9	34

[a] Section L represents Kagati Lake.
[b] Partial survey due to inclement weather.

Table 6.–Summary of movement information for radiotagged rainbow trout detected during consecutive surveys in the Kanektok River, 2009–2011.

Dates of surveys	Days between surveys	Sample size	Net movement (rkm)		Upstream movement		Downstream movement (rkm)	
			Mean	SD	Max	Min	Max	Min
Tagging 8/16/09	4-13	184	1.1	1.5	9.0	0.1	7.6	0.1
8/16/09 9/23/09	38	91	2.2	4.0	5.2	0.3	27.6	0.1
9/23/09 10/3/09	10	71	1.4	2.5	3.4	0.1	18.3	0.1
10/3/09 10/26/09	23	90	1.4	2.5	6.8	0.1	13.6	0.1
10/26/09 11/17/09	22	105	5.3	8.0	7.0	0.1	35.9	0.1
11/17/09 12/23/09	36	94	7.3	10.3	17.8	0.1	48.1	0.1
12/23/09 1/21/10	29	75	4.2	6.3	6.1	0.1	23.7	0.1
1/21/10 2/11/10	21	75	0.8	1.0	5.3	0.1	4.3	0.1
2/11/10 3/19/10	36	87	1.1	1.9	12.4	0.1	8.0	0.1
3/19/10 4/9/10	21	83	0.5	0.7	1.8	0.1	5.3	0.1
4/9/10 4/27/10	18	81	1.4	2.7	6.9	0.1	20.6	0.1
4/27/10 5/3/10	6	78	0.9	1.3	5.1	0.1	9.1	0.1
5/3/10 5/12/10	9	70	2.8	4.1	19.1	0.1	16.2	0.1
5/12/10 5/18/10	6	55	2.2	4.3	13.0	0.1	24.6	0.1
5/18/10 5/24/10	6	61	2.9	5.9	25.1	0.1	13.0	0.1
5/24/10 6/5/10	12	74	6.1	10.3	66.0	0.1	31.7	0.1
6/5/10 6/10/10	5	66	2.3	6.0	37.6	0.1	11.1	0.1
6/10/10 6/21/10	11	54	3.2	6.9	28.1	0.1	34.6	0.1
6/21/10 7/5/10	14	14	5.4	7.9	23	0.1	0.5	0.1

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Dates of surveys	Days between surveys	Sample size	Net movement (rkm)		Upstream movement		Downstream movement (rkm)	
			Mean	SD	Max	Min	Max	Min
7/5/10 7/22/10	17	16	1.3	3.8	15.7	0.2	0.7	0.1
7/22/10 8/18/10	27	56	1.8	4.2	17.6	0.1	24.6	0.1
8/18/10 10/6/10	49	44	1.0	2.6	16.0	0.1	6.0	0.1
10/6/10 11/3/10	28	47	1.0	1.9	12.0	0.1	4.8	0.1
11/3/10 11/19/10	16	49	3.8	5.0	10.8	0.1	21.1	0.2
11/19/10 1/6/11	48	36	10.4	16.6	6.4	0.2	84.7	0.1
1/6/11 2/10/11	35	37	2.8	5.2	4.7	0.1	19.6	0.1
2/10/11 3/15/11	33	32	1.3	2.4	3.2	0.1	12.1	0.1
3/15/11 4/1/11	17	24	0.5	0.8	3.4	0.1	2.6	0.1
4/1/11 4/13/11	12	21	0.8	1.0	2.7	0.1	4.1	0.2
4/13/11 5/2/11	19	27	1.3	2.6	4.0	0.1	13.4	0.1
5/2/11 5/11/11	9	35	2.7	3.6	8.3	0.1	16.5	0.1
5/11/11 5/27/11	16	30	5.5	9.1	26.7	0.1	39	0.2
5/27/11 6/6/11	10	24	3.0	8.3	40.8	0.1	2.9	0.1
6/6/11 6/15/11	9	28	1.1	2.2	10.6	0.1	1.6	0.1
6/15/11 7/5/11	20	21	5.1	9.9	40.9	0.1	1.6	0.2
7/5/11 8/10/11	36	20	3.8	6.5	20.6	0.1	17.4	0.2

[a] Absolute values of net movement were used to calculate mean distances traveled.

Table 7.–Minimum, maximum, and mean home range of radiotagged rainbow trout in the Kanektok River from 2009 to 2011. Home range was calculated using the distance traveled from the uppermost extent to the lower most extent for individual rainbow trout over the course of an approximate year, Kanektok River, 2009–2011.

Time Period	Active fish (N)	Home range (rkm)			
		Mean	SD	Max.	Min.
Tagging (8/3-8/12/2009) to 2nd summer (8/18/2010)	62	21.2	21.1	108.7	1.0
2nd summer (8/18/2010) to 3rd summer (8/10/2011)	30	19.2	23.7	112.1	1.0

Table 8.–Home range frequency of radiotagged rainbow trout reported as a proportion by river section during the first year of the study (early August 2009 through 18 August 2010), Kanektok River. Mean home ranges and standard deviations (SD) are reported for each river section.

River Section	Active fish (n)	Home range (rkm)											
		0.0-5.0	5.1-10.0	10.1-15.0	15.1-20.0	20.1-25.0	25.1-30.0	30.1-35.0	35.1-40.0	40.1-70.0	>70	Mean	SD
A	2	-	0.50	-	-	0.50	-	-	-	-	-	15.6	11.7
B	5	-	0.40	0.20	0.40	-	-	-	-	-	-	12.1	6.5
C	5	0.40	0.20	0.40	-	-	-	-	-	-	-	8.0	4.3
D	11	0.55	0.18	-	0.09	-	0.09	-	0.09	-	-	9.7	11.9
E	9	0.11	0.22	0.33	0.11	0.11	0.11	-	-	-	-	13.1	7.2
F	8	-	0.13	0.13	-	0.13	0.25	0.13	0.25	-	-	25.4	10.0
G	4	0.25	0.25	-	-	0.25	-	-	-	0.25	-	22.8	26.2
H	5	-	-	0.20	-	-	0.20	0.20	-	0.20	0.20	47.2	37.9
I	7	0.14	-	0.29	0.29	-	0.14	-	-	-	0.14	23.4	24.0
K	6	-	-	0.17	-	-	-	0.17	-	0.50	0.17	44.6	23.8
All	62	0.18	0.16	0.18	0.10	0.06	0.10	0.05	0.05	0.08	0.05	21.2	21.1

Table 9.–Home range frequency of radiotagged rainbow trout reported as a proportion by river section during the second year of the study (18 August 2010 through 10 August 2011), Kanektok River. Mean home ranges and standard deviations (SD) are reported for each river section.

River Section	Active fish (n)	Home range (rkm)										Mean	SD
		0.0-5.0	5.1-10.0	10.1-15.0	15.1-20.0	20.1-25.0	25.1-30.0	30.1-35.0	35.1-40.0	40.1-70.0	>70		
A	1	1.00	-	-	-	-	-	-	-	-	-	NA	-
B	4	0.50	0.25	-	0.25	-	-	-	-	-	-	6.3	6.2
C	2	0.50	0.50	-	-	-	-	-	-	-	-	3.7	2.4
D	4	0.75	0.25	-	-	-	-	-	-	-	-	3.4	3.0
E	5	0.20	-	0.20	0.40	-	0.20	-	-	-	-	15.7	9.0
F	4	0.25	-	-	0.25	-	-	0.25	-	-	0.25	31.3	29.0
G	2	-	-	-	-	-	0.50	0.50	-	-	-	28.8	4.5
H	4	-	0.25	-	-	-	0.25	-	-	0.25	0.25	48.7	45.6
I	3	-	0.33	0.33	0.33	-	-	-	-	-	-	13.4	6.7
K	1	-	-	-	-	-	1.00	-	-	-	-	NA	-
All	30	0.30	0.17	0.07	0.17	0.00	0.13	0.07	0.00	0.03	0.07	19.2	23.7

Table 10.–Fidelity of radiotagged rainbow trout to summertime tagging locations measured in river kilometers (rkm) and reported as mean, maximum, and minimum distances. August surveys were used to describe summertime fidelity, Kanektok River, 2009–2011.

Time period	Active fish (n)	Measured distance (rkm)		
		Mean	Maximum	Minimum
Tagging (8/3-8/12/2009) to 2nd summer (8/18/2010)	62	2.7	35.1	0.0
2nd summer (8/18/2010) to 3rd summer (8/10/2011)	30	2.8	34.9	0.0

APPENDICES

Appendix A.–Summary of data archives for the Kanektok River rainbow trout telemetry study, 2009–2011.

Year	Data file[a]	Software
2012	KanektokRiver_rainbowtrout_telemtrydata.xls	Microsoft Excel 2007

[a] Data files are archived at and are available from the Alaska Department of Fish and Game, Sport Fish Division, Research and Technical Services, 333 Raspberry Road, Anchorage, Alaska 99518-1599.

Appendix B.–Summary information for rainbow trout radiotagged in the Kanektok River, 3–12 August 2009.

Date	Floy Tag #	FL (mm)	Radio Tag Frequency 162.xxx MHz	Radio Tag Code	River Section	Latitude Decimal Degrees	Longitude Decimal Degrees	Final fate	Survey Date of Final Fate Assignment	Days Alive
8/12/2009	71	582	319	20	A	59.7821	-161.8256	Missing	8/16/2009	4
8/12/2009	254	450	319	24	A	59.7833	-161.8151	Mortality	8/16/2009	4
8/12/2009	119	635	319	42	A	59.7850	-161.8015	Mortality	11/17/2009	97
8/12/2009	120	537	319	43	A	59.7722	-161.8591	Mortality	6/6/2011	663
8/12/2009	200	557	319	46	A	59.7817	-161.7617	Missing	11/17/2009	97
8/12/2009	202	540	344	6	A	59.7771	-161.8295	Alive	8/10/2011	728
8/12/2009	121	594	344	7	A	59.7722	-161.8591	Missing	8/16/2009	4
8/12/2009	117	558	344	8	A	59.7837	-161.7518	Missing	10/3/2009	52
8/12/2009	73	512	344	74	A	59.7769	-161.8411	Missing	8/16/2009	4
8/12/2009	253	522	344	75	A	59.7838	-161.7557	Mortality	8/16/2009	4
8/12/2009	256	580	356	30	A	59.7711	-161.8435	Missing	8/16/2009	4
8/12/2009	255	528	356	31	A	59.7817	-161.8258	Alive	8/10/2011	728
8/12/2009	201	547	356	56	A	59.7849	-161.7980	Mortality	8/16/2009	4
8/12/2009	204	524	356	57	A	59.7659	-161.8640	Alive	8/10/2011	728
8/12/2009	118	488	356	58	A	59.7837	-161.7898	Mortality	10/3/2009	52
8/12/2009	252	510	381	21	A	59.7849	-161.7470	Mortality	8/16/2009	4
8/12/2009	69	472	381	22	A	59.7772	-161.7668	Mortality	8/16/2009	4
8/12/2009	203	454	381	41	A	59.7702	-161.8578	Mortality	8/16/2009	4
8/12/2009	70	444	381	44	A	59.7829	-161.7887	Missing	8/16/2009	4
8/12/2009	72	473	381	45	A	59.7821	-161.8256	Mortality	8/16/2009	4
8/10/2009	194	446	381	33	B	59.8038	-161.5042	Mortality	8/16/2009	6
8/11/2009	64	452	319	19	B	59.8041	-161.5204	Mortality	10/26/2009	76
8/11/2009	116	468	319	35	B	59.7860	-161.6964	Alive	8/10/2011	729
8/11/2009	114	486	319	38	B	59.8049	-161.6077	Alive	8/10/2011	729
8/11/2009	199	432	319	39	B	59.7842	-161.7323	Missing	5/27/2011	654

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Date	Floy Tag #	FL (mm)	Radio Tag Frequency 162.xxx MHz	Radio Tag Code	River Section	Latitude Decimal Degrees	Longitude Decimal Degrees	Final Fate	Survey Date of Final Fate Assignment	Days Alive
8/11/2009	66	445	344	9	B	59.8053	-161.5971	Mortality	8/16/2009	5
8/11/2009	115	541	344	10	B	59.8052	-161.6552	Mortality	12/23/2009	134
8/11/2009	112	515	344	11	B	59.8042	-161.5403	Missing	6/21/2010	314
8/11/2009	296	440	344	72	B	59.8026	-161.6196	Mortality	8/16/2009	5
8/11/2009	297	495	344	73	B	59.8079	-161.5843	Mortality	8/16/2009	5
8/11/2009	67	522	356	32	B	59.8067	-161.6014	Alive	8/10/2011	729
8/11/2009	251	460	356	33	B	59.7877	-161.7029	Alive	8/10/2011	729
8/11/2009	195	479	356	59	B	59.8038	-161.5320	Missing	8/16/2009	5
8/11/2009	198	563	356	60	B	59.7964	-161.6712	Missing	6/10/2010	303
8/11/2009	65	490	356	61	B	59.8038	-161.5434	Missing	8/16/2009	5
8/11/2009	298	490	381	16	B	59.8032	-161.5180	Mortality	8/16/2009	5
8/11/2009	113	458	381	17	B	59.8098	-161.5570	Mortality	8/16/2009	5
8/11/2009	197	450	381	36	B	59.8010	-161.6271	Mortality	8/16/2009	5
8/11/2009	196	433	381	37	B	59.8062	-161.5464	Mortality	8/16/2009	5
8/11/2009	68	480	381	40	B	59.7965	-161.6639	Mortality	8/16/2009	5
8/10/2009	295	505	319	13	C	59.8043	-161.4687	Missing	7/5/2011	694
8/10/2009	300	460	319	14	C	59.8011	-161.4884	Mortality	8/16/2009	6
8/10/2009	110	445	319	30	C	59.8177	-161.4252	Missing	8/10/2009	0
8/10/2009	106	451	319	31	C	59.8230	-161.3850	Missing	11/19/2010	466
8/10/2009	193	587	319	34	C	59.8129	-161.4431	Mortality	8/16/2009	6
8/10/2009	191	484	344	12	C	59.8201	-161.4006	Mortality	8/16/2009	6
8/10/2009	105	438	344	13	C	59.8232	-161.3803	Missing	6/21/2010	315
8/10/2009	107	462	344	14	C	59.8190	-161.4135	Mortality	5/18/2010	281
8/10/2009	294	430	344	70	C	59.8149	-161.4366	Mortality	8/16/2009	6
8/10/2009	292	439	344	71	C	59.8238	-161.3298	Mortality	10/3/2009	54
8/10/2009	290	450	356	34	C	59.8204	-161.3136	Alive	8/10/2011	730

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Date	Floy Tag #	FL (mm)	Radio Tag Frequency 162.xxx MHz	Radio Tag Code	River Section	Latitude Decimal Degrees	Longitude Decimal Degrees	Final Fate	Survey Date of Final Fate Assignment	Days Alive
8/10/2009	293	495	356	35	C	59.8149	-161.4366	Mortality	8/16/2009	6
8/10/2009	190	430	356	62	C	59.8283	-161.3580	Missing	6/5/2010	299
8/10/2009	103	430	356	63	C	59.8244	-161.3694	Alive	8/10/2011	730
8/10/2009	104	437	356	64	C	59.8244	-161.3694	Mortality	11/17/2009	99
8/10/2009	291	465	381	11	C	59.8224	-161.3234	Mortality	8/16/2009	6
8/10/2009	111	447	381	15	C	59.7984	-161.4812	Alive	8/10/2011	730
8/10/2009	189	457	381	29	C	59.8237	-161.3253	Mortality	8/16/2009	6
8/10/2009	192	440	381	32	C	59.8135	-161.4418	Mortality	4/1/2011	599
8/11/2009	299	455	319	18	C	59.8044	-161.4987	Mortality	8/16/2009	5
8/9/2009	288	435	319	8	D	59.8142	-161.2859	Mortality	3/19/2010	222
8/9/2009	289	430	319	12	D	59.8142	-161.2859	Mortality	1/6/2011	515
8/9/2009	47	441	319	48	D	59.8005	-161.1364	Alive	8/10/2011	731
8/9/2009	102	438	319	49	D	59.8160	-161.2544	Missing	5/11/2011	640
8/9/2009	186	431	319	50	D	59.8049	-161.1866	Mortality	8/18/2010	374
8/9/2009	184	496	344	15	D	59.7928	-161.1354	Mortality	2/11/2010	186
8/9/2009	50	473	344	16	D	59.8038	-161.1737	Mortality	8/16/2009	7
8/9/2009	49	463	344	17	D	59.8038	-161.1737	Mortality	7/22/2010	347
8/9/2009	285	432	344	68	D	59.8019	-161.1443	Alive	8/10/2011	731
8/9/2009	283	475	344	69	D	59.7881	-161.1141	Mortality	1/6/2011	515
8/9/2009	287	475	356	36	D	59.8180	-161.2630	Mortality	11/19/2010	467
8/9/2009	284	451	356	37	D	59.7925	-161.1308	Mortality	8/18/2010	374
8/9/2009	188	455	356	65	D	59.8173	-161.2756	Alive	8/10/2011	731
8/9/2009	187	445	356	66	D	59.8178	-161.2481	Mortality	8/16/2009	7
8/9/2009	48	462	356	67	D	59.8018	-161.1585	Mortality	8/16/2009	7
8/9/2009	286	470	381	9	D	59.8172	-161.2422	Alive	8/10/2011	731
8/9/2009	101	454	381	10	D	59.8038	-161.1737	Mortality	5/2/2011	631

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Date	Floy Tag #	FL (mm)	Radio Tag Frequency 162.xxx MHz	Radio Tag Code	River Section	Latitude Decimal Degrees	Longitude Decimal Degrees	Final Fate	Survey Date of Final Fate Assignment	Days Alive
8/9/2009	183	434	381	28	D	59.7928	-161.1291	Mortality	8/16/2009	7
8/9/2009	185	432	381	51	D	59.8029	-161.1510	Mortality	6/10/2010	305
8/8/2009	51	486	319	6	E	59.7158	-160.9761	Missing	8/18/2010	375
8/8/2009	43	462	319	7	E	59.7316	-160.9964	Mortality	8/16/2009	8
8/8/2009	278	512	319	27	E	59.7157	-160.9444	Mortality	11/17/2009	101
8/8/2009	54	463	319	44	E	59.7483	-161.0493	Mortality	4/27/2010	262
8/8/2009	24	465	319	45	E	59.7140	-160.9351	Alive	8/10/2011	732
8/8/2009	25	465	344	18	E	59.7140	-160.9351	Mortality	8/16/2009	8
8/8/2009	52	430	344	19	E	59.7278	-160.9958	Mortality	10/3/2009	56
8/8/2009	280	480	344	65	E	59.7454	-161.0362	Missing	8/8/2009	0
8/8/2009	277	458	344	66	E	59.7126	-160.9323	Alive	8/10/2011	732
8/8/2009	46	518	344	67	E	59.7710	-161.0670	Alive	8/10/2011	732
8/8/2009	45	437	356	38	E	59.7453	-161.0415	Mortality	9/23/2009	46
8/8/2009	44	478	356	39	E	59.7316	-160.9964	Mortality	10/3/2009	56
8/8/2009	279	460	356	40	E	59.7170	-160.9693	Alive	8/10/2011	732
8/8/2009	180	458	356	68	E	59.7146	-160.9522	Mortality	7/22/2010	348
8/8/2009	282	445	356	69	E	59.7740	-161.0801	Mortality	8/16/2009	8
8/8/2009	276	500	381	3	E	59.7126	-160.9323	Missing	6/21/2010	317
8/8/2009	53	435	381	4	E	59.7459	-161.0365	Mortality	8/16/2009	8
8/8/2009	182	528	381	5	E	59.7152	-160.9630	Mortality	8/8/2009	0
8/8/2009	181	514	381	46	E	59.7152	-160.9630	Alive	8/10/2011	732
8/8/2009	281	450	381	47	E	59.7454	-161.0362	Missing	6/15/2011	676
8/9/2009	58	475	344	61	[b] E	59.7134	-160.9839	Mortality	10/6/2010	423
8/9/2009	59	520	356	44	[b] E	59.7134	-160.9839	Alive	8/10/2011	731
8/9/2009	60	495	381	19	[b] E	59.7162	-160.9860	Mortality	5/27/2011	656
8/10/2009	62	458	319	16	[c] E	59.7293	-161.0099	Alive	8/10/2011	730

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Date	Floy Tag #	FL (mm)	Radio Tag Frequency 162.xxx MHz	Radio Tag Code	River Section	Latitude Decimal Degrees	Longitude Decimal Degrees	Final Fate	Survey Date of Final Fate Assignment	Days Alive
8/10/2009	63	516	344	60	[c] E	59.7306	-161.0099	Missing	10/6/2010	422
8/10/2009	61	485	356	46	[c] E	59.7293	-161.0099	Mortality	2/11/2010	185
8/7/2009	226	495	319	21	F	59.7329	-160.8495	Alive	8/10/2011	733
8/7/2009	230	435	319	22	F	59.7620	-160.8027	Alive	8/10/2011	733
8/7/2009	179	515	319	23	F	59.7446	-160.8312	Alive	8/10/2011	733
8/7/2009	178	441	319	40	F	59.7628	-160.7995	Mortality	11/17/2009	102
8/7/2009	174	529	319	41	F	59.7898	-160.7590	Mortality	12/23/2009	138
8/7/2009	176	497	344	20	F	59.7628	-160.7995	Mortality	8/7/2009	0
8/7/2009	41	475	344	21	F	59.7294	-160.8648	Mortality	8/16/2009	9
8/7/2009	227	500	344	62	F	59.7393	-160.8412	Mortality	8/7/2009	0
8/7/2009	231	512	344	63	F	59.7692	-160.7950	Mortality	5/27/2011	658
8/7/2009	42	525	344	64	F	59.7141	-160.8974	Mortality	8/16/2009	9
8/7/2009	38	600	356	41	F	59.7808	-160.7719	Mortality	6/10/2010	307
8/7/2009	232	470	356	42	F	59.7840	-160.7692	Missing	8/16/2009	9
8/7/2009	228	455	356	43	F	59.7393	-160.8412	Mortality	8/16/2009	9
8/7/2009	175	486	356	70	F	59.7773	-160.7791	Mortality	8/7/2009	0
8/7/2009	40	565	356	71	F	59.7421	-160.8337	Mortality	12/23/2009	138
8/7/2009	229	495	381	24	F	59.7440	-160.8323	Mortality	8/16/2009	9
8/7/2009	39	484	381	25	F	59.7793	-160.7829	Mortality	9/23/2009	47
8/7/2009	177	496	381	26	F	59.7628	-160.7995	Mortality	11/19/2010	469
8/7/2009	173	519	381	42	F	59.7898	-160.7590	Alive	8/10/2011	733
8/7/2009	172	447	381	43	F	59.7963	-160.7387	Mortality	5/11/2011	642
8/9/2009	56	604	319	36	[a] F	59.7857	-160.7564	Missing	7/5/2011	695
8/9/2009	57	540	344	23	[a] F	59.7857	-160.7564	Missing	8/9/2009	0
8/9/2009	55	490	381	52	[a] F	59.7837	-160.7539	Mortality	5/24/2010	288
8/6/2009	236	480	319	9	G	59.8232	-160.7235	Mortality	8/6/2009	0

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Date	Floy Tag #	FL (mm)	Radio Tag Frequency 162.xxx MHz	Radio Tag Code	River Section	Latitude Decimal Degrees	Longitude Decimal Degrees	Final Fate	Survey Date of Final Fate Assignment	Days Alive
8/6/2009	234	530	319	15	G	59.8024	-160.7310	Mortality	10/6/2010	426
8/6/2009	36	486	319	17	G	59.8501	-160.7006	Mortality	1/21/2010	168
8/6/2009	167	458	319	37	G	59.8365	-160.7096	Mortality	11/19/2010	470
8/6/2009	N/A	565	344	22	G	59.8804	-160.6007	Alive	8/10/2011	734
8/6/2009	238	463	344	56	G	59.8589	-160.6801	Mortality	8/6/2009	0
8/6/2009	235	514	344	59	G	59.8198	-160.7259	Mortality	10/26/2009	81
8/6/2009	37	478	356	45	G	59.8501	-160.7006	Mortality	8/16/2009	10
8/6/2009	N/A	633	356	72	G	59.8306	-160.7142	Mortality	1/21/2010	168
8/6/2009	169	461	356	73	G	59.8365	-160.7096	Mortality	10/26/2009	81
8/6/2009	233	445	381	18	G	59.7999	-160.7344	Alive	8/10/2011	734
8/6/2009	170	488	381	20	G	59.8102	-160.7250	Missing	8/6/2009	0
8/6/2009	168	475	381	38	G	59.8365	-160.7096	Mortality	12/23/2009	139
8/6/2009	171	454	381	39	G	59.8102	-160.7250	Mortality	2/10/2011	553
8/4/2009	160	430	356	74	H	59.8996	-160.3391	Mortality	8/16/2009	12
8/5/2009	242	505	319	10	H	59.8759	-160.4359	Alive	8/10/2011	735
8/5/2009	30	506	319	11	H	59.8769	-160.4483	Mortality	8/16/2009	11
8/5/2009	32	452	319	[c]32	H	59.8805	-160.5858	Mortality	12/23/2009	140
8/5/2009	162	497	319	33	H	59.8995	-160.3387	Mortality	10/6/2010	427
8/5/2009	164	480	344	24	H	59.8763	-160.4257	Mortality	3/19/2010	226
8/5/2009	34	542	344	25	H	59.8805	-160.5858	Mortality	11/3/2010	455
8/5/2009	243	502	344	57	H	59.8892	-160.3852	Mortality	5/24/2010	292
8/5/2009	35	490	344	58	H	59.8805	-160.5858	Missing	10/3/2009	59
8/5/2009	31	466	356	47	H	59.8763	-160.5153	Alive	8/10/2011	735
8/5/2009	241	540	356	48	H	59.8762	-160.4433	Mortality	12/23/2009	140
8/5/2009	239	522	356	49	H	59.8787	-160.5908	Mortality	5/24/2010	292
8/5/2009	161	485	356	75	H	59.8995	-160.3387	Mortality	10/26/2009	82

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Date	Floy Tag #	FL (mm)	Radio Tag Frequency 162.xxx MHz	Radio Tag Code	River Section	Latitude Decimal Degrees	Longitude Decimal Degrees	Final Fate	Survey Date of Final Fate Assignment	Days Alive
8/5/2009	240	433	381	12	H	59.8780	-160.4676	Alive	8/10/2011	735
8/5/2009	33	530	381	13	H	59.8805	-160.5858	Missing	8/16/2009	11
8/5/2009	166	460	381	14	H	59.8808	-160.5385	Mortality	8/16/2009	11
8/5/2009	165	500	381	34	H	59.8763	-160.4257	Mortality	8/16/2009	11
8/5/2009	163	517	381	35	H	59.8763	-160.4257	Alive	8/10/2011	735
8/3/2009	201	595	344	26	I	59.8978	-160.1658	Alive	8/10/2011	737
8/3/2009	202	475	356	76	I	59.8915	-160.1789	Mortality	8/18/2010	380
8/4/2009	247	550	319	3	I	59.9083	-160.3008	Mortality	5/27/2011	661
8/4/2009	244	570	319	4	I	59.9012	-160.3346	Mortality	6/10/2010	310
8/4/2009	29	630	319	5	I	59.9018	-160.3338	Mortality	4/1/2011	605
8/4/2009	27	479	319	28	I	59.9082	-160.2949	Mortality	8/16/2009	12
8/4/2009	156	640	319	29	I	59.9071	-160.2863	Mortality	10/26/2009	83
8/4/2009	28	488	344	27	I	59.9018	-160.3338	Mortality	11/17/2009	105
8/4/2009	248	490	344	53	I	59.9057	-160.2704	Mortality	8/16/2009	12
8/4/2009	249	680	344	54	I	59.9068	-160.2608	Missing	8/16/2009	12
8/4/2009	157	530	344	55	I	59.9019	-160.2863	Mortality	5/2/2011	636
8/4/2009	158	524	356	50	I	59.9019	-160.2863	Alive	8/10/2011	736
8/4/2009	250	610	356	51	I	59.8908	-160.1923	Mortality	6/21/2010	321
8/4/2009	245	498	356	52	I	59.9012	-160.3346	Mortality	11/17/2009	105
8/4/2009	154	481	356	77	I	59.8916	-160.1889	Mortality	8/4/2009	0
8/4/2009	246	431	381	6	I	59.9012	-160.3346	Mortality	6/21/2010	321
8/4/2009	159	445	381	7	I	59.9019	-160.2863	Alive	8/10/2011	736
8/4/2009	26	498	381	8	I	59.9049	-160.2506	Mortality	8/18/2010	379
8/4/2009	155	537	381	30	I	59.8916	-160.1889	Mortality	6/5/2010	305
8/4/2009	153	507	381	31	I	59.8916	-160.1889	Mortality	8/16/2009	12
8/3/2009	1	505	344	76	K	59.7730	-160.3508	Mortality	3/15/2011	589

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Date	Floy Tag #	FL (mm)	Radio Tag Frequency 162.xxx MHz	Radio Tag Code	River Section	Latitude Decimal Degrees	Longitude Decimal Degrees	Final Fate	Survey Date of Final Fate Assignment	Days Alive
8/3/2009	2	465	381	23	K	59.7730	-160.3508	Mortality	4/9/2010	249
8/4/2009	3	562	344	3	K	59.7963	-160.3879	Mortality	5/3/2010	272
8/4/2009	4	600	344	5	K	59.8266	-160.3864	Mortality	8/16/2009	12
8/4/2009	5	571	344	77	K	59.8266	-160.3864	Mortality	11/17/2009	105
8/5/2009	6	603	344	4	K	59.8321	-160.3922	Mortality	10/26/2009	82
8/5/2009	12	448	356	28	K	59.8433	-160.4036	Mortality	8/18/2010	378
8/5/2009	11	455	356	54	K	59.8382	-160.4007	Mortality	1/21/2010	169
8/5/2009	7	592	356	55	K	59.8365	-160.4019	Mortality	5/24/2010	292
8/5/2009	10	500	381	27	K	59.8382	-160.4007	Alive	8/10/2011	735
8/5/2009	9	568	381	49	K	59.8365	-160.4019	Mortality	6/21/2010	320
8/6/2009	14	548	319	25	K	59.8566	-160.4431	Mortality	10/26/2009	81
8/6/2009	16	439	319	26	K	59.8566	-160.4471	Mortality	8/16/2009	10
8/6/2009	23	560	319	47	K	59.8665	-160.4590	Mortality	8/16/2009	10
8/6/2009	13	500	319	51	K	59.8498	-160.4318	Mortality	11/19/2010	470
8/6/2009	22	448	319	52	K	59.8601	-160.4548	Mortality	7/22/2010	350
8/6/2009	20	594	356	29	K	59.8582	-160.4497	Mortality	11/19/2010	470
8/6/2009	18	501	356	53	K	59.8582	-160.4497	Mortality	8/18/2010	377
8/6/2009	21	541	381	48	K	59.8590	-160.4520	Mortality	1/6/2011	518
8/6/2009	15	437	381	50	K	59.8569	-160.4452	Mortality	2/11/2010	189

[a] Fish was tagged in lower 1 km of Klak Creek.

[b] Fish was tagged in lower 1 km of Nukluk Creek.

[c] Fish was tagged in lower 1 km of Takshilik Creek.